DEEP SUBMERSIBLE LOGISTIC SUPPORT DESIGN CONCEPT

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THESIS

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by

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ABSTRACT

This thesis proposes a simplification of the logistic and operational problems of deep submersibles using a support craft-submersible combination. Shown is an improved vehicle launch and recovery method and a means to transfer personnel, supplies, and services during sea conditions presently detrimental to such operations. The combination is shown as capable of short range operations close to port as a complete unit, but for distant areas, the combination, which is air transportable, may require tending services of an available larger ship. A scale model of the combination was built to illustrate a method for support craft and submersible bow-to-stern mating concept. Designs for the submersible indicate how the system components can accommodate an elevator to reduce vehicle drag and to make equipment accessible for maintenance. Efficient buoyancy material is important to the idea. Small diameter porcelain spheres were made and tested to show the feasibility of sphere-syntactic foam conglomerate for buoyancy at 20,000 feet.

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I. INTRODUCTION

A. DEFINITION OF DEEP SUBMERSIBLE

A deep submersible is a submarine vehicle capable of operating in ocean depths of several thousand to twenty thousand feet or greater. This vehicle may be manned, unmanned, tethered or nontethered. It is a craft too limited by size and mission to make it a self-sustaining ship, thus requiring extensive logistic support.

B. NEED FOR DEEP SUBMERSIBLE

To implement national policy, governments require deep submersibles to establish, inspect and protect their oceanic interests and to do the exploratory work necessary to establish claims to underwater resources under international law. Search and rescue responsibilities require a deep submersible to be prepared to respond to events such as the THRESHER, Palomares H-bomb and the SCORPION crises. Record-making feats, such as TRIESTE'S dive to 36,800 feet, add to national prestige.

Submersible craft are instruments for scientific research. Short term, well defined research objectives requiring deep submersibles exist in the fields of pollution control, food production and mineral exploration. Long term, more generalized investigations are certain to find application in the future.

C. PROBLEM OF DEEP SUBMERSIBLE

A seaworthy deep submersible which can provide economic dividends commensurate with the money required to remain operational does not exist. The high cost of operating is related to the methods of logistic support rendered to the deep submersible while on the ocean's surface. Even moderate sea states cause difficulty in transferring personnel and heavy equipment, for providing routine services between a support ship and deep submersible and in launching and recovering the craft. Costly delays of days or weeks occur due to the weather. Transportation of the submersible to the diving operation site is an additional requirement which often proves difficult and expensive to accomplish.

D. SUGGESTED PROBLEM SOLUTION

Most of the logistic problems outlined in the preceding section could be reduced if the submersible and a small support craft could be locked together with a mechanical coupling through which personnel and materials could transfer and services could be accomplished in moderate sea states. The configuration would be an economical, seaworthy unit capable of riding out rough seas if the weather deteriorated. For operations near port, the submersible and support craft would operate independent of additional assistance; while in remote locations, a tender ship may be required to be available in the area. The ability to transport the submersible and support craft components of the modular system by aircraft would be a desirable feature.

The weight of materials used to fabricate submersibles operating at great depths requires a means for external buoyancy which should be adjustable to compensate for equipments changes. To achieve this, a

solid buoyancy module of syntactic foam-porcelain sphere conglomerate is proposed. The buoyancy module reduces submersible size and weight while eliminating problems associated with liquid and gas floatation systems.

Sensing systems such as cameras, hydrophones, personnel sphere, etc., which presently are mounted externally on the submersible's hull, remain underwater when the vehicle is on the surface. The systems are inaccessible for maintenance and are exposed to wave damage. An elevator, containing the vulnerable equipment, lowered from within the submersible would correct the exposure faults.

A discussion of the problems presented and a proposed solution is given in this thesis.

E. APPROACH TO THE SOLUTION

This thesis first acquaints the reader with the primary handling and supply complexities associated with deep submersibles. Secondary logistic problems, including those listed in TABLE I, are also discussed. The design parameters for a system which will alleviate these problems are then deduced. A syntactic foam composite, a key design parameter, is investigated in greater detail to determine the feasibility of including a matrix of porcelain spheres for the overal reduction of submersible size and weight without sacrificing deep depth capability. Based on the design characteristics determined to this point, a reasonable, inexpensive method to test the idea is formulated.

A scale model of support craft, locking device and submersible was constructed. The submersible model shows how the elevator works in the raised and lowered positions. The model was tested in a tank to determine its response to water motions. These subjects are discussed in subsequent sections.

TABLE I

DEEP SUBMERSIBLE SUPPORT REQUIREMENTS AND SYSTEMS

1. High Pressure Air Charging
2. SCUBA Diving
3. Battery Charging
4. Reballasting
5. Short Range Communication via Sound Powered Phones, Walkie-Talkie, and UHF
6. Performing Maintenance Routines
7. Maintaining Equipment Certification and Safety Standards
8. Repair Parts Stowage and Inventory
9. Fire Prevention
10. Compressed Gas Stowage and Handling
11. Running Lights
12. Ground Tackle
13. Small Boats

II. REVIEW OF SUBMERSIBLE LOGISTIC PROBLEMS

A. BACKGROUND

The submersible, as a type of submarine designed to penetrate the deepest ocean, is a relatively new invention. The first bathyscaph, a manned submersible designated FNRS-2, was built in 1948 by Auguste Piccard. During sea trials, heavy swell caused personnel in charge of handling the bathyscaph to lose control with the resulting accidental, unmanned dive to 4,527 feet as related by Sweeney [Ref. 1]. The designer, Piccard, had given insufficient thought to the logistics of handling his submersible at the ocean's surface. Although sometimes taken for granted or even ignored in discussions of submersibles, logistic support is as important to undersea exploration as the vehicle itself. In the opinion of Horton [Ref. 2] "at least 60% of the cost of manned submersible systems and 75% of the operating problems are associated with the surface."

The loss of the USS THRESHER (SSN593) in 1963 motivated the formation of the Deep Submergence Systems Review Group (DSSRG) to study submersible problems and make recommendations for their correction. A survey of the literature concerning submersible logistic problems including the DSSRG final report [Ref. 3], numerous magazine and journal articles, technical reports, and books points out the three major areas of surface logistic problems as:

Transportation, launch and recovery
Transfer of personnel and materials between submersible and support ship
Buoyancy control.

Subcategories of these areas include battery charging, ballasting, air charging, safety certification, and navigation and communication maintenance.

The approach to supporting submersibles has followed two schools of thought - the ship oriented and the submersible oriented methods. The ship oriented version considers the submersible as one of several tools used to collect information, operating only as an extension of the ship. The submersible oriented method presents the submersible as the primary element of the organization, while the support ship, designed to provide services for the vehicle, exists in a secondary position.

Support requirements vary with the type of submersible, be it of shallow or deep water design. The shallow depth vehicle relies solely on the use of air systems for major buoyancy control and carries the majority of machinery and equipment within the pressure hull for protection from ambient water conditions. The deep submersible maintains buoyancy control by flooding tanks and dropping weights. Motors, batteries, electrical boxes, pumps, winches, etc. are externally located, exposed to water pressure and temperature variations.

B. TRANSPORTATION, LAUNCH AND RECOVERY

Sea state is the greatest natural hazard to successful submersible operations. A support vessel provides transportation to the diving location, carrying the submersible cradled on board or towed astern. Support vessels require crane and winch systems especially designed to handle heavy loads swinging with the motions of the ship. The sinking of the submersible ALVIN illustrates that present handling system designs which have been engineered to maximum capability within their sea state limitations are still not completely satisfactory. When sea state causes moderate pitch and roll, the pendulum motion and high dynamic loading imparted to a crane-suspended load is difficult, if not impossible, to control, thus preventing submersible operations. Possible deterioration

of the weather during a dive can change a placid sea surface present at dive commencement to cresting waves during recovery operations several hours later. An example is the irretrievable loss of a CURV vehicle off the coast of Washington state when the control cable fouled, then snapped, during a rough sea recovery attempt.

The Deep Submergence Rescue Vehicle, DSRV, system utilizes an underwater mating technique to attempt to eliminate sea state problems. In describing this technique, the literature states that the DSRV must maneuver to dock on the afterdeck of a submarine or to land on a platform suspended from a surface ship. Since submersibles require prompt recovery and often terminate a dive because of low power capacity, this system may reduce sea state problems, but may not adequately solve the logistic support problems. The design concept reported herein proposes a submersible which would be adaptable to known surface support techniques, yet provide a submerged support technique where maneuverability of the submersible is not a critical factor in its recovery.

The variety of transportation, launch and recovery systems creates a man-imposed logistic problem. Craven and Searle [Ref. 4] describe the frustrations of working with the heterogeneous submersible systems assembled for the H-bomb recovery off Palomares. The systems were not adaptable to interface logistically with each other or with support ships available in the area.

The proposed concept is adaptable because it includes an air-transportable support craft which provides the necessary interface between any support ship available and the submersible. Additionally, the concept defines a basic framework which, if used for different submersible designs, would standardize handling techniques and servicing routines.

C. INTERACTION BETWEEN SUBMERSIBLE AND SUPPORT SHIP

The logistic interactions between a submersible and its support ship during diving operations include the exchange of information, personnel, and material with frequency of exchange governed by the type and mission of the submersible being serviced. In general, deeper diving, more complex vehicles require greater servicing, thus being more reliant on external assistance. Sea state limits the ability to accomplish interactions. The capability of maintaining logistic contact presently diminishes markedly when sea state three is exceeded.

The exchange of information requires means for communication. Those utilized during logistic support of submersibles include megaphones, sound powered phones, portable walkie-talkies, and installed UHF radios, each imposing certain logistic requirements to make them operate satisfactorily.

The exchange of equipment and personnel requires the utilization of small boats such as rubber life boats, outboard motor-powered skiffs and diesel-driven whale boats. The ability of a small boat to come alongside a pitching submersible for the transfer of personnel and equipment risks collision, personnel injury, and material loss. Invariably, wave activity will douse everything which, for personnel, is inconvenient, but for electrical equipment, is intolerable.

The personnel traveling between the two vessels might include SCUBA divers, safety inspectors, repair technicians, operating pilots, etc. Attachments being transferred include one or more lines and hoses or cables as required to accomplish the following evolutions: battery charging, reballasting, air charging, dehumidifying, and electrical grounding. The rigging systems involved are a challenge to even the most capable boatswain mate. Equipment being transported to or from the

submersible includes: portable running lights, radios, tools, cameras, and consumable items, such as lubricating oils and grease. Transferring services over the water is a limiting factor to submersible operations. ALUMINAUT, for example, was forced to retreat from heavy seas to sheltered waters to accomplish battery charging without taking on water through the open hatch.

Discussed to this point have been interactions between submersible and support ship while operating at the ocean's surface. For submerged operations, the support ship must preposition the submersible for the dive to take place in the geographic area of interest. This navigational aid continues throughout the dive via underwater sound communication. In addition, the support ship must track the submersible to remain above it and be able to recover the submersible after surfacing. The logistics of maintaining this interaction requires a quiet vessel for listening, presenting a problem to the surface ship with noisy equipment.

To overcome this difficulty, intermediate vessels such as motor whale boats are employed to relay communications between submersible and command control ship. Utilization of a submarine for a support ship, as in the DSRV system, improves tracking efficiency for it is a quiet platform designed for listening. In addition, the submarine can operate beneath water temperature gradients which spoil sonar transmission.

The dependence of a deep submersible on a surface support ship seems to be inherent to its operation even though it is a requirement fraught with problems. To solve the problems encountered during interactions between submersible and support ship, the proposed concept utilizes a

support craft designed to couple directly to the stern of the submersible. Thus mated, the water gap and relative motion situations are eliminated. Logistic servicing can then be accomplished with greater ease and under safer working conditions. When uncoupled, the support craft, equipped to track and communicate with its submerged vehicle, becomes a command control platform.

D. BUOYANCY CONTROL

Buoyancy is controlled by flooding or pumping tanks or by releasing positive or negative buoyancy materials. To maintain the proper stability and attitude of a submersible, correct ballasting must be achieved. The center of buoyancy must remain above the center of gravity during submerged activity.

The logistics of ballasting a deep submersible such as TRIESTE require gasoline and steel shot to be pumped to the bathyscaph while it is towed astern of its support ship. Twenty-six tons of steel shot is transferred to the submersible for every dive. Gasoline which is substantially more compressible than sea water requires the continual release of shot for the submersible to maintain near neutral buoyancy control as it descends. For example, approximately twelve tons of shot must be dropped to maintain neutral buoyancy at 36,000 feet.

Aside from the logistics of transferring shot to the submersible, other problems exist. Steel shot corrodes rapidly in the oxygen-rich surface waters. The oxides bind the shot into clumps which fail to fall through the funnelshaped bottom of the shot tube; therefore, it is advisable to dump any remaining shot following a dive and take on twenty-six tons of known corrosion-free shot. A full load is required

because only when the tubs are full, can the operator be assured he has dropped the correct amount prior to commencing a dive in order to maintain the desired near-neutral trim control. Adopting the proposed concept would drastically reduce the amount of shot required and the logistics of handling it.

The choice of buoyancy material is so influential to the ultimate design of a submersible that the various types and associated problems require discussion. It is difficult to construct a small vehicle of strong materials that is buoyant at substantial operating depths. The total weight of the vehicle is greater than the volume of water displaced; therefore, supplemental buoyancy is needed. Table II provides a list of lighter than water materials which can be used to provide buoyancy. For submersibles, only three have been used to any extent; they are compressed air, syntactic foam, and gasoline. To date, only one, gasoline used in floats for manned bathyscaphs, has worked to take a vehicle down to 10,000 feet or greater.

Figures 1 and 2 depict the bathyscaph TRIESTE before and after it is filled with 66,018 gallons of aviation gasoline. TRIESTE must be filled with gasoline while being towed approximately 300 feet behind its support ship. To transfer gasoline requires a complex rigging system and consumes precious days of operating time. If sea conditions increase while TRIESTE is filled with gasoline, there is no alternative but to tow her until calm seas permit degassing and redocking. Should repairs require redocking, many more days of operating time would be lost. Gasoline cannot be left aboard TRIESTE either while docking, as her draft would not clear the sill, or when in the support ship dry dock as her structural members could not support the weight.

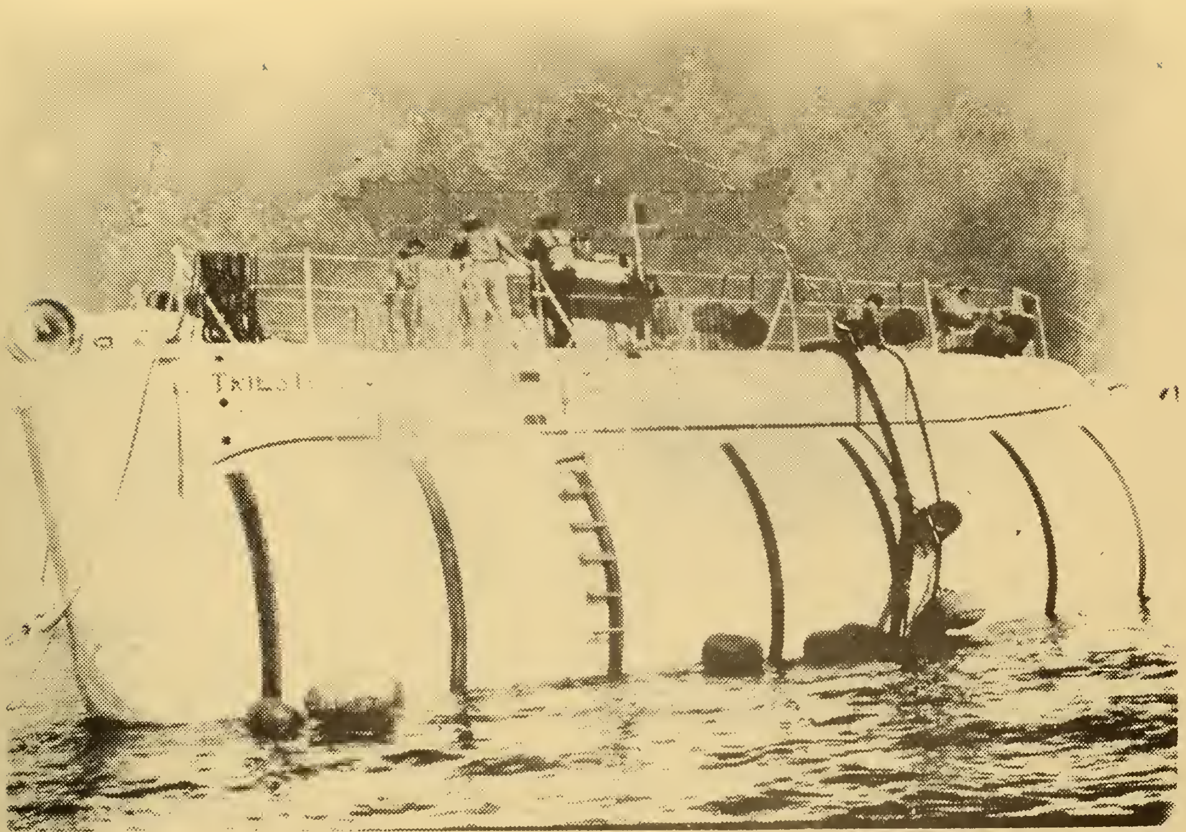


FIGURE 1. TRIESTE (DSV-1) PRIOR TO GASSING

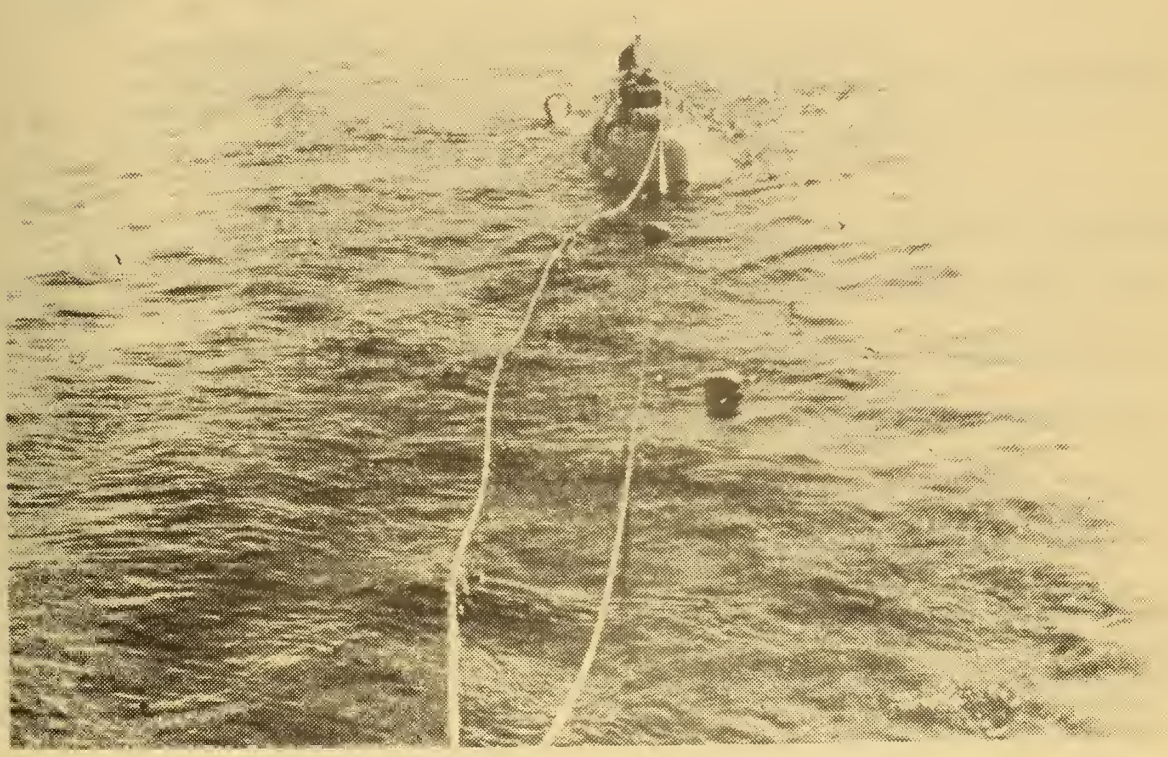


FIGURE 2. TRIESTE (DSV-1) GASSING COMPLETED

TABLE II

LIGHTER THAN WATER BUOYANCY MATERIALS

MATERIAL	REMARKS
Gasses	
Air	Highly compressible
Hydrogen	High thermal contraction
Helium	Toxic or flammable
Nitrogen	
Liquids	
Gasoline	Compressibility varies with depth,
Ethyl Alcohol	subjected to temperature change
Ammonia Solutions	
Kerosene	
Turpentine	
Oils	
Solids	
Glass Microspheres	Reactive metals
Macrospheres	Macrospheres subject to sympathetic
Lithium	implosions
Syntactic Foam Composites	Absorption problems
Sodium	

The logistics of gasoline supplemental buoyancy necessitates extra safety precautions. To prevent explosive vapors from being ignited by a careless spark, static electricity, or the sun's concentrated heat, the floatation tanks are kept filled with nitrogen gas. This is vented to the atmosphere when the float is filled prior to diving. After degassing, the nitrogen is passed via hose from the stowage bottles on the support ship to TRIESTE. After dry docking, extensive ventilation is conducted until the monitors show all traces of gasoline vapor have evaporated. Static-free clothing is required and spark-producing tools

and heat generating systems such as the galley range are secured until vapor free conditions are guaranteed. This can be a habitability inconvenience, especially in tropic waters with the air conditioning plant shut down. The use of large quantities of fluid for supplemental buoyancy requires piping systems, electrically operated valves, and many one-of-a-kind handling systems for logistic servicing.

The use of syntactic foam for supplemental buoyancy is highly desirable and fits into any future submersible designs. It is a composite material of hollow glass microspheres and a resin matrix. The low density of the microspheres, which ranges from approximately 15 to 25 lb/ft^3, permits the fabrication of a family of buoyancy materials in density ranges of approximately 30 to 44 lb/ft^3; the higher density foams possess the greater strength necessary for deep ocean applications. The variations in density are due to the type of resin used and number of microspheres packed into a given volume of foam.

To increase the buoyancy of a given volume of syntactic foam, Stechler and Resnick [Ref. 5] suggest imbedding one to four inch hollow spheres within the foam. References 6 through 10 discuss the development of a syntactic foam-sphere conglomerate which yields an optimized module in the shape of a hexagonal-based prism. Ianuzzi [Ref. 9] states "it should be possible to make up large blocks by cementing together flat plates (of syntactic foam) with multiple cavities."

The proposed concept advances the buoyancy module development by investigating porcelain spheres for their strength and buoyancy characteristics. A sphere-foam conglomerate able to work at 20,000 feet is designed to be logistically supportable. The proposed concept permits buoyancy module adjustment to compensate for equipment additions or deletions that ballasting alone cannot accomplish.

In concluding the overall discussion of submersible logistic problems, the various ship and vehicle oriented support ships have been reviewed. The interactions between the support ship and submersible have been discussed and the methods used to provide supplemental buoyancy from compressible gasoline to solid syntactic foam were related. The problems were presented with respect to present operational systems and the proposed concept advanced as a solution which is further explained in the following sections.

III. DESCRIPTION OF CONCEPT COMPONENTS

A. PORCELAIN SPHERES

1. Background

As noted in Section II, improvement of syntactic foam buoyancy could be achieved by the introduction of small pressure-resistant spheres. Spheres made of materials which have high compressive strength-to-weight characteristics are desirable. Materials which have been investigated for this purpose include aluminum, annealed and tempered glass, alumina and fiber reinforced plastics. Porcelain, a member of the ceramic family known to have desirable compressive strength-to-weight property, appears to have been overlooked. Part of the work of this thesis was concerned with the making and testing of porcelain spheres, then designing a sphere-syntactic foam conglomerate that would be a practical buoyancy module for applications in deep submergence.

Preliminary experiments in manufacture of a monolithio porcelain sphere were carried out using a Christmas tree ornament as a pattern for the plaster mold. Figure 3 shows the ornament lying inside the two halves of the mold. Using this mold, a spheroid with obvious flaws and lack of sphericity was produced. Measurements showed the spheroid to have a specific gravity equivalent to syntactic foam and an average diameter of two inches. In spite of the flaws, it survived at pressures of 14,200 lb/in^2, the maximum that could be obtained by the hydraulic system of the testing facility at that time. After an hour at depth, the spheroid was retrieved for inspection and broken to measure shell thickness.

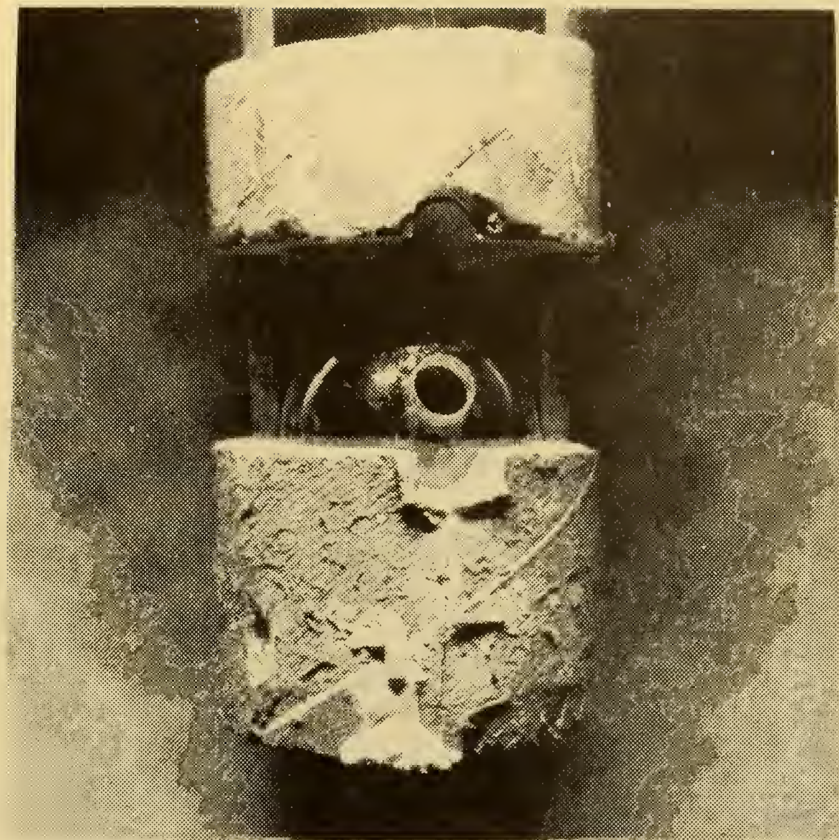


FIGURE 3. CHRISTMAS TREE ORNAMENT AND TWO INCH SPHERE MOLD

To produce better quality porcelain spheres of various diameters, more precise equipment was assembled, using the facilities of a machine and mold shop. The following section explains the assemblage and manufacturing details in further detail.

2. Description of Sphere Molds

To obtain finished spheres of good sphericity required a mold of the same quality. Solid aluminum spheres with diameters of 2 1/3, 3 1/3, and 4 1/3 inches were machined and polished to 1/1000 inch accuracy. The oversize diameter required allowance for plaster mold and porcelain sphere shrinkage when completely dried. Using the solid aluminum sphere pattern, plaster molds were poured. After several trial-and-error attempts, good molds were produced. Three molds of each diameter were made; Figure 4 shows a four inch mold. Note that it was made in two interlocking halves with a pour hole centered in one hemisphere.

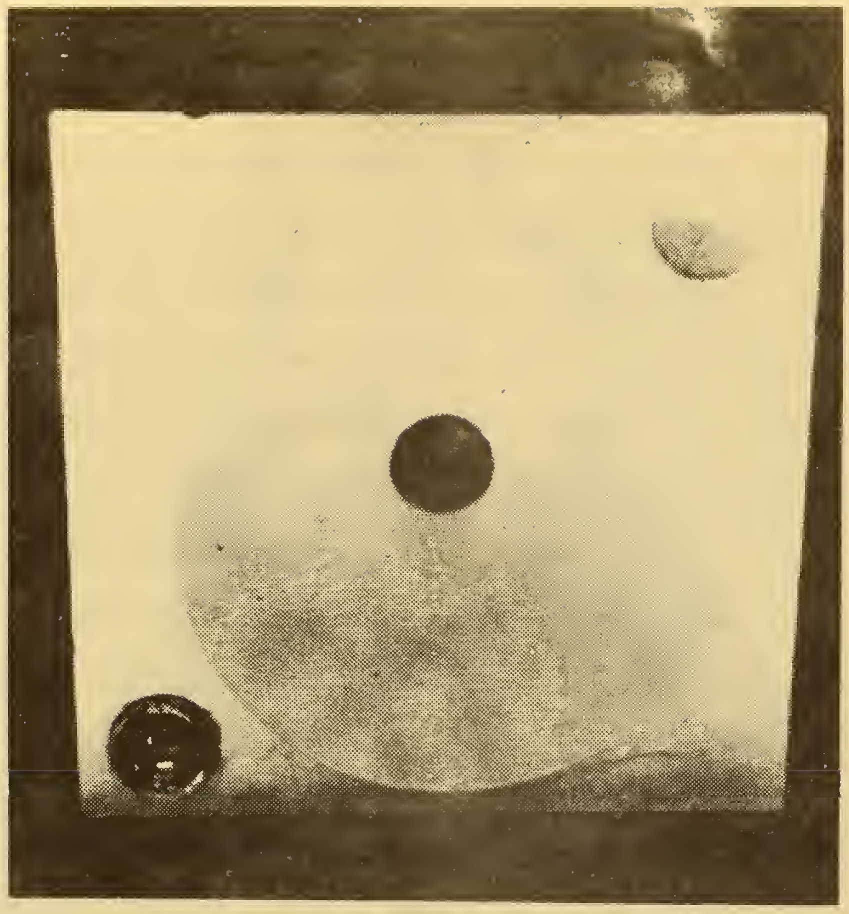


FIGURE 4. FOUR INCH SPHERE HALF MOLD

3. Sphere Manufacturing

The two halves of the mold are banded together and positioned with the opening on top. Porcelain slip is poured into the opening until the mold is full. After a short interval, depending on shell thickness desired, the mold is turned over. Shells of 1/10 inch thickness take about 40 seconds to set up. After the mold is reversed and excess slip has drained from within the cavity, residual slurry in the neck of the opening is trimmed. A volume of slurry calculated to fill the remainder of the shell opening is injected by syringe into the opening. A plug is inserted to seal the hole and the mold is rotated so that the slip will distribute itself over the opening. The mold is then set aside for several hours to allow the porcelain within to dry and shrink from the plaster.

After sufficient drying time, the mold sections are separated to reveal a perfectly produced spherical shell of slightly less diameter than the original aluminum sphere. A pinhole is pressed through the shell to prevent fracture by air compressed as the shell shrinks. The pinhole also prevents the sphere from exploding during the firing process. After firing, the pinhole is filled with epoxy. Figure 5 is a finished four inch sphere cradled in its mold to provide a comparison of size from beginning to completion of manufacturing.

Developing the techniques outlined above was not without its problems which included improper plug closure and cracks developing in the sphere resulting from premature opening of the mold. Several methods were employed to plug the sphere opening. After experimentation, new molds were cast with shallow neck openings and fitted plugs to facilitate rapid trimming of excess slip and easy insertion of the plug.

The two inch shells came out reasonably spherical; however, the larger shells tended to develop flat spots on the side where the shell rested during firing. Improvised supports such as wedges and dishes had only limited success in preventing the flattening shown in Figure 6. To correct this difficulty, a support which fits the sphere and is made of a high melting temperature material might be used, but time allowance did not permit experimentation with this idea.

4. Sphere Pressure Testing

All tests were conducted in the 12-inch converted gun barrel pressure test facility at the Naval Postgraduate School, Monterey, California, during March 1972. Forty spheres of various diameters were tested. Of the 63 produced, 23 had succumbed to manufacturing flaws or handling mishaps.

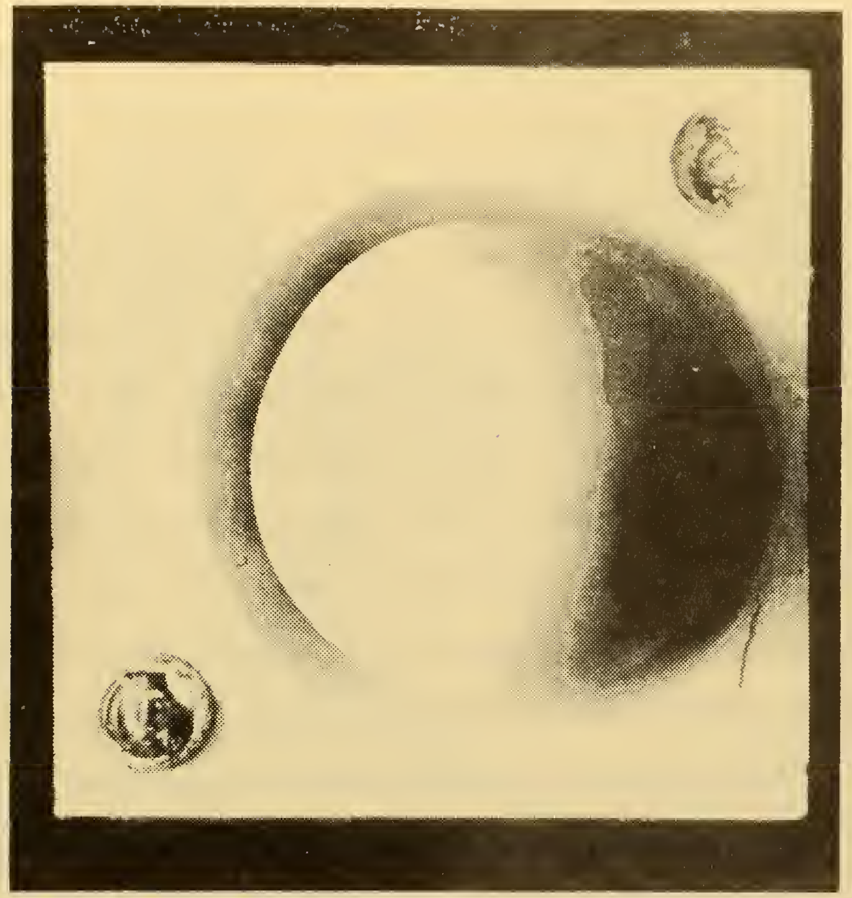


FIGURE 5. PORCELAIN SPHERE CRADLED IN MOLD

FIGURE 6. SPHERE FAILURE AT FLAT SPOT

Prior to testing, the remaining spheres were weighed and volume measured to provide data for computing their apparent specific gravity. Apparent specific gravity will be noted as ASG in the rest of the text. During testing the spheres were wrapped in a plastic mesh which had a weight tied to it. The mesh held the sphere submerged in the center of the test chamber. Spheres were selected at random for a variety of tests which included different loading rates, number of cycles and implosion characteristics. No spheres were instrumented with strain gauges because a penetrator was not available for wires to enter the pressure vessel.

The use of the pressure testing system required an initial assembly of components to achieve higher operating pressures and the sriting of a set of operating instructions. Problems were minor with the exception of time and physical energy required to manually open and lift the muzzle breech mechanism. The number of spheres tested at any one time was limited by operator fatigue, rather than mechanical difficulties.

5. Sphere Data

Commercially prepared porcelain slurry was obtained from the ceramic hobby shop, Fort Ord, California. The slurry formula was proprietary information, but based on a measured bulk specific gravity of 2.56, a rough estimate for Youngs Modules of 14.5×10^6 lb/in^2 is assured for the resulting fire ceramics. A compressive strength for this type of porcelain is 100,000 lb/in^2. To determine shell thickness, it was assumed that pieces of broken shell could be measured; however, the spheres were so badly fragmented by the implosion that flat spots present before failure could not be determined. To resolve this problem, spheres with obvious defects or flat spots were broken open. Thickness was determined for segments of the sphere to calculate an average shell

FIGURE 7. BROKEN SPHERICAL SHELL

thickness. Shell thickness for unbroken spheres of similar ASG was assumed to be similar. Figure 7 shows a sphere broken for this purpose.

A measurement of selected chips after implosion showed no major deviation from this assumption. Ultrasonic or X-ray measurements of shell thickness would have been desirable, but the equipment was not available. Sphericity was measured semi-qualitatively by the repeated ability of a shell to roll freely on a flat surface and come to rest without preference to a particular axis of orientation. All two inch diameter spheres and one three inch diameter sphere passed the sphericity test. A more complicated device for sphericity measurements can be devised using a vise to hold the sphere on a turntable. A dial indicator fixed to a platform adjacent to the turntable would record any deviation in local sphere radius as the turntable was rotated.

TABLE III

PRESSURE TEST DATA FOR TWO INCH DIAMETER
PORCELAIN SPHERES

SPHERE DIA- #	PRESSURE/DEPTH KPSI	KFT	ASG	REMARKS
2 - 1	14.2	29.0	.438	WALL THICKNESS .070 INCH +/- .005 ORIGINAL SPHERE
2 - 2	13.5	27.6	.453	NO SYMPATHETIC IMPLOSION WHEN TESTED WITH # 3-3
2 - 3	13.8	28.2	.441	
2 - 4	----	----	.440	BROKEN FOR SHELL THICKNESS .063 INCH +/- .005
2 - 5	13.7	28.0	.439	
2 - 6	13.2	27.0	.433	
2 - 7	6.1	12.5	.436	CRACKED DURING TEST SHELL THICK .064 IN +/- .005
2 - 8	13.6	27.8	.450	
2 - 9	14.2	29.0	.455	CYCLED 5 TIMES TO 14,000 THEN HELD 12 HOURS
2 -10	14.1	28.8	.430	
2 -11	8.0	16.3	.436	PIN HOLE BLOWOUT THICKNESS .066 INCH +/- .005
2 -12	13.6	27.8	.451	SYMPATHETIC IMPLOSION WITH SPHERE # 2-16
2 -13	13.9	28.4	.426	
2 -14	15.0	30.7	.471	CYCLED 6 TIMES TO 14,200 THEN TESTED TO FAILURE
2 -15	14.2	29.0	.438	
2 -16	13.6	27.8	.429	SYMPATHETIC IMPLOSION WITH SPHERE # 2-12
2 -17	14.3	28.2	.430	CYCLED 10 TIMES TO 14,200 THEN TESTED TO FAILURE

AVERAGES

SHELL THICKNESS = 0.065 INCH

DEPTH FOR FAILURE = 28,379 FEET
(DISCOUNTING 2-4, 2-7 AND 2-11)

APPARENT SPECIFIC GRAVITY = 0.440

TABLE IV

PRESSURE TEST DATA FOR THREE INCH DIAMETER PORCELAIN SPHERES

SPHERE DIA- #	PRESSURE/DEPTH KPSI	KFT	ASG	REMARKS
3 - 1	----	----	.396	BROKEN FOR THICKNESS .048 INCH +/- .005
3 - 2	----	----	.434	BROKEN FOR THICKNESS .061 INCH +/- .005
3 - 3	2.1	4.3	.433	
3 - 4	???	----	.429	FLOODED DURING TEST NO FAILURE OBSERVED
3 - 5	2.6	5.3	.378	
3 - 6	3.3	6.3	.396	
3 - 7	6.1	12.5	.411	FAILURE AT FLAT SPOT SEE FIGURE 7
3 - 8	6.3	12.9	.405	
3 - 9	2.0	4.1	.389	CRACKED DURING TEST THICKNESS .053 IN +1- .005
3 -10	8.8	18.0	.409	VERY GOOD SPHERICITY
3 -11	4.5	9.2	.399	

AVERAGES

SHELL THICKNESS = 0.054 INCH

DEPTH FOR FAILURE = 9,056 FEET
(DISCOUNTING 3-1, 3-2 AND 3-4)

APPARENT SPECIFIC GRAVITY = 0.406

TABLE V

PRESSURE TEST DATA FOR FOUR INCH DIAMETER PORCELAIN SPHERES

SPHERE DIA- #	PRESSURE/DEPTH KPSI	KFT	ASG	REMARKS
4 - 1	____	____	.292	BROKEN FOR THICKNESS .039 INCH +/- .005
4 - 2	1.0	2.0	.223	CRACKED DURING TEST
4 - 3	.8	1.6	.254	THICKNESS .040 INCH +/- .005
4 - 4	4.2	8.6	.308	
4 - 5	3.1	6.3	.300	FLAT SPOT FAILURE
4 - 6	7.0	14.3	.312	FLAT SPOT FAILURE
4 - 7	6.3	12.9	.331	TOTAL FAILURE
4 - 8	2.1	4.3	.293	CRACKED THICKNESS .041 INCH +/- .005
4 - 9	4.0	8.2	.310	COMPLETE FAILURE

AVERAGES

SHELL THICKNESS = 0.040 INCH

DEPTH FOR FAILURE = 7,300 FEET (ALL SPHERES)

APPARENT SPECIFIC GRAVITY = 0.292

Tables III through V summarize the data obtained for spheres used in this investigation. The information indicates that two inch diameter spheres can be made which provide more buoyancy per weight of material than syntactic foam. The spheres have suitable strength properties to resist implosion at 20,000 feet. Increasing ASG with larger diameter spheres is related to the time allowed for the slip to set in the mold before it was inverted to drain the excess. The larger sphere molds produced thinner shells for an equivalent slip set-up time.

6. Sphere Matrix in Syntactic Foam

As mentioned in the introduction, hexagonal blocks of foam with spheres arranged in a hexagonal close pack matrix appears to be the optimum buoyancy module. Because of the danger of sympathetic implosion, the spheres must be separated by a designated interval. The exact separation interval for a given diameter sphere has not yet been defined. In a later section, an approach to investigating and defining the interval is provided. To illustrate the nature of the buoyancy module, Figure 8 presents various combinations of spheres and layering that can be achieved. A module of approximately 75 pounds would be a convenient weight for logistic handling and will be considered as the limiting weight in the following calculations. A conglomerate module of Figure 8 would have a greater buoyancy/strength ratio than a solid module of only foam. The properties of the sphere would be improved by the foam. The shells would be somewhat stiffened against collapse and the spheres would be protected against accidental damage.

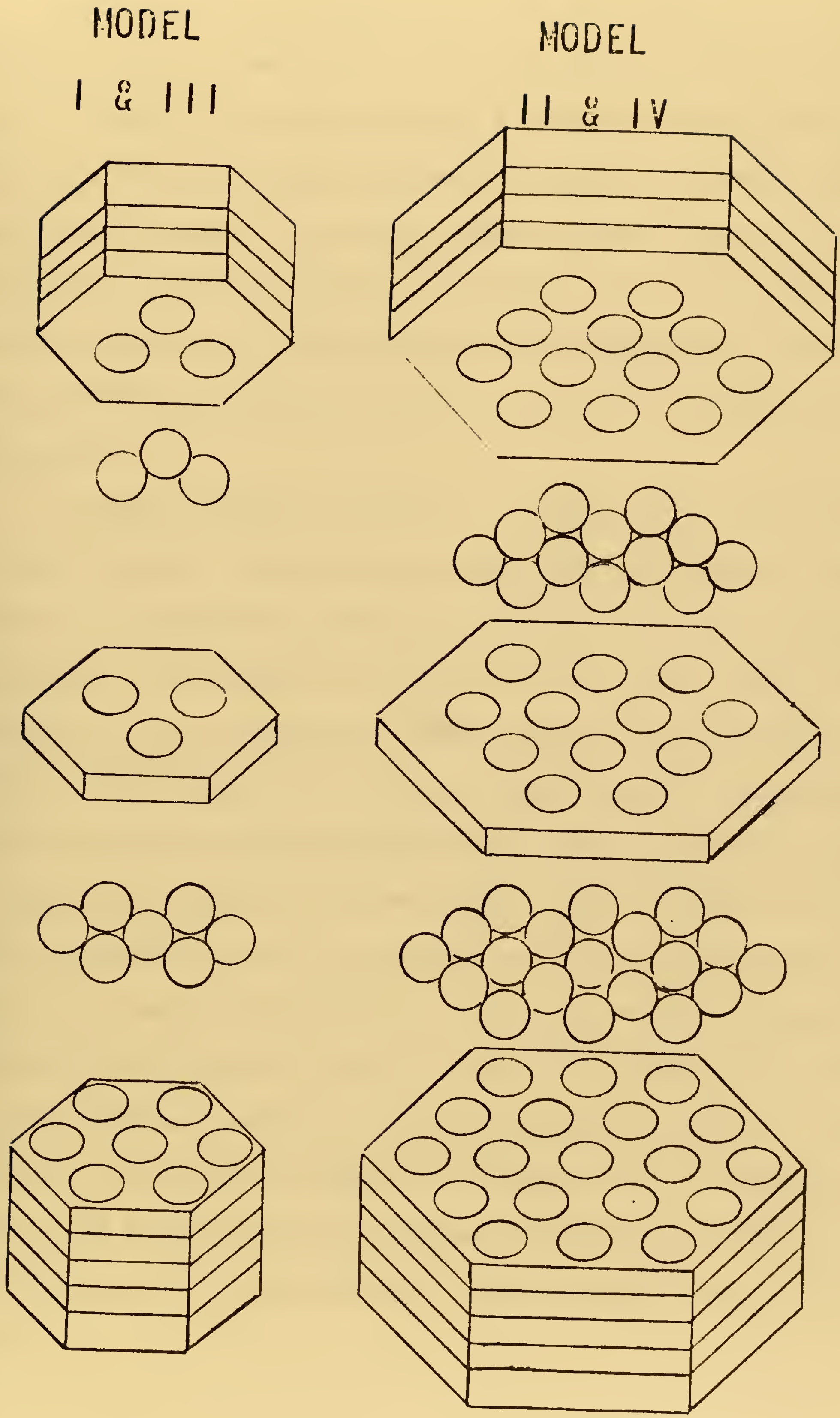


FIGURE 8. BUOYANCY MODULES WITH SPHERE MATRIX

Four methods of assembling the block were used, in order to determine the design parameters of an actual sphere-foam conglomerate. Models I through IV sketched in Figure 8 illustrate these methods. Model I assumes a base layer of seven spheres while Model III assumes a base layer of three spheres. In similar fashion, Models II and IV are constructed with 19 and 12 spheres, respectively, used in the base layer. Specific gravities for foam and sphere were assigned while the spacing between adjacent spheres was increased by 0.10 inch increments to 1.40 inch maximum.

A digital computer was used to calculate the various combinations of sphere diameters, sphere intervals and sphere and syntactic foam densities to determine the dimensions and buoyancy of the resulting conglomerate. For comparative purposes, the net buoyancy gain of the conglomerate over an equivalent volume of solid syntactic foam was also computed. The tabulation of these calculations and the program which generated the data follows the conclusions found at the end of this thesis. The computations indicate that the initial number of spheres in the base layer has negligible effect on buoyancy of the constructed model in a group, i.e, I and II or II and IV. To use the computer program to calculate the net buoyancy gain for a block of syntactic foam with unsupported spherical cavities the entering argument, ASG, can be set equal to zero. A trade off of strength in the module with the porcelain spheres absent could be advantageous for buoyancy applications at lesser depths. This information is also provided in the tabulation at the end of the thesis.

From the tabulated data, a sphere-foam conglomerate module incorporating two-inch spheres and a one-half inch spacing interval of the Model II type is chosen for further calculations. Specific gravities of 0.45 and 0.58 for sphere and foam respectively lead to dimensions of 13.4 inches diameter and 31.8 inches height for an approximately 70 pound module, which has a lower density than an equivalent solid volume of foam. In this example, approximately two pounds net buoyancy increase is achieved for each 70 pound module. Reference 11 states that a deep submersible may require between 50 to 80 thousand pounds of solid syntactic foam for vehicle supplemental buoyancy. Replacing solid syntactic foam with the buoyancy module conglomerate could reduce vehicle weight by approximately 1400 to 2300 pounds. The overall weight reduction would also decrease vehicle size requirements. Additional space and weight savings are achieved when solid floatation is compared to gasoline floatation. For example, over half of the 26 tons of steel shot ballast used on TRIESTE to compensate for gasoline compressibility would be eliminated, as would about one-third of the 8820 cubic feet of gasoline.

B. SUPPORT CRAFT DEVELOPMENT

1. Objectives

The task is to solve the general problems of transfer of personnel, materials and services which were discussed in the introduction. The solution has been approached by several methods which include hoisting the submersible to the deck of a support ship, by bringing the submersible onto a dry docking platform of a support ship and by mating in a piggyback fashion on a support submarine. The following section suggests a new approach to solving the basic problems.

2. Bow to Stern Support Mating

a. Background

Three articles of the numerous references surveyed implied an end to end mating concept. The first is by Terry [Ref. 12] who suggests submarines be designed with interchangeable bows designed for particular missions such as torpedoes, mines, bulk cargo, petroleum, missiles, etc. The second mention of end to end mating was proposed by Friedman [Ref. 13] where the bow of a submarine was a control module that could function as a rescue chamber by jettisoning the stern section should an incident prevent the entire submarine from surfacing. A sketch implying end to end submersible coupling is in an article by Dimitriadia [Ref. 14].

To investigate the feasibility of bow to stern mating, an economical first step would be to modify a ship such as a readily available amphibious landing craft.

b. Landing Craft Modification

Landing craft have seen numerous modifications to their basic framework to provide task-oriented craft for river patrol, mine sweeping, diver support, etc. Figure 9 shows a 1/4 inch = 1 foot scale model of an LCM (6). All attempts to procure a model or blueprints of an actual LCM (6) met with negative results; the dimensions for the constructed model were taken from information listed in Table VI, obtained from Janes Fighting Ships 1971-72 [Ref. 15]. A wind-up spring motor for a toy boat was utilized to provide propulsion power. Because of space limitations only one spring motor could be fitted into the model.

TABLE VI

LCM (6) CHARACTERISTICS

DISPLACEMENT, TONS:	55 (full load)
DIMENSIONS, FEET:	56.2 x 14 x 3.9
MAIN ENGINES:	2 diesels, 2 shafts
	450 shp = 9 knots
CONSTRUCTION:	Welded steel

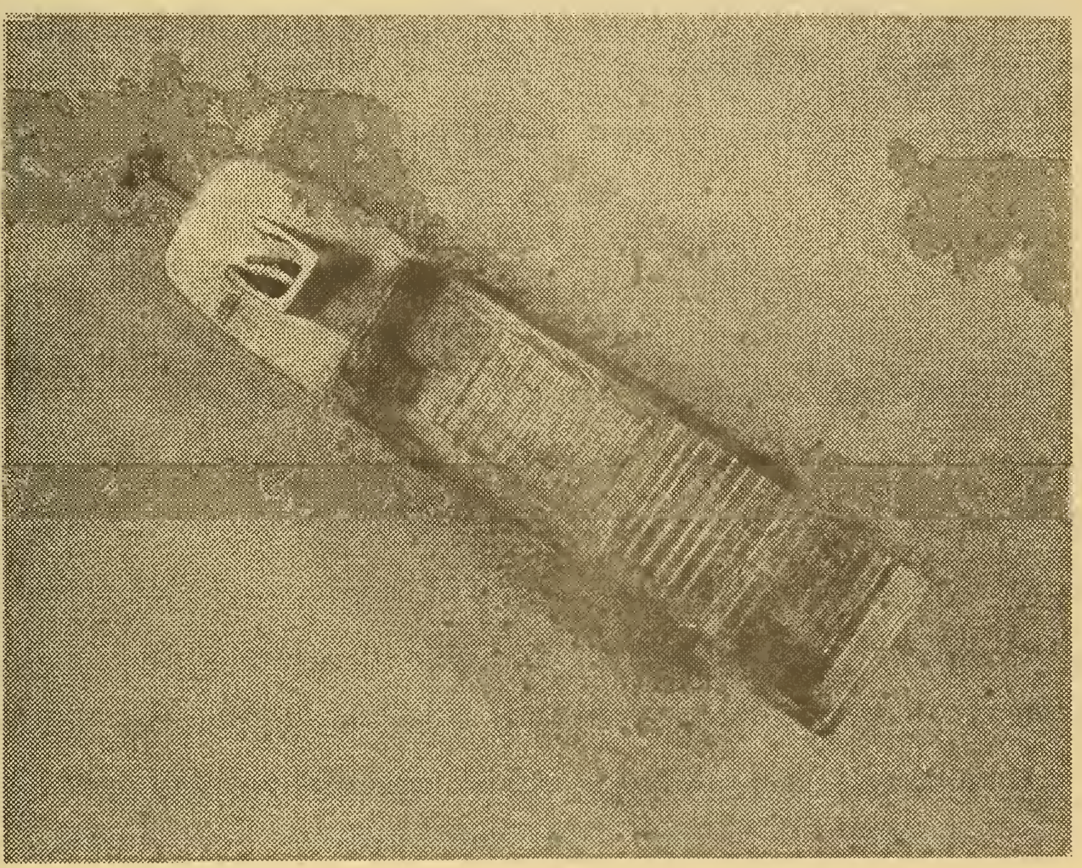


FIGURE 9. MODEL OF LCM (6)

The first decision in modification was to limit the length of the support craft to fifty feet. The modified LCM (6), shown in Figures 10 and 11, will be redesignated for the remainder of this thesis as LCSS or Logistic Craft Submersible Support. A bow coupling device to be discussed in greater detail is installed in the forward section of the LCSS. The interior of the LCSS can be loaded with portable support equipment in port, prior to shipboard launch, by a boat alongside or by crane. The portable support equipment would be chosen from the items listed in Table VII to meet the specific needs of the mission. The normal mission of the LCM (6) is to transport tanks, vehicles and men through the surf zone; therefore, it should satisfy similar requirements at sea during submersible operations. The two-shaft, two-diesel craft should be able to provide sufficient power to guide and control the submersible locked to the bow of the LCSS.

3. Coupling Systems

a. Model Coupling Device

The device used to lock the two models together had to operate on correct alignment contact of the LCSS and submersible. It was desired to keep the device simple to eliminate the requirements for a remote control wire or electronic controls. It was anticipated that the two models would be tested in a tow tank to observe their response to wave actions separately, when mated and after coupling. Figures 10 and 11 show the assembled apparatus in the cocked and triggered positions respectively.

TABLE VII

PORTABLE SUPPORT EQUIPMENT

1. Battery Charging

   Diesel/Generator Unit
   Battery Monitoring Equipment
   Connecting Cables

2. Personnel Accomodations

   Berthing for Two or Three Persons
   Sanitary Facilities
   Refrigerator

3. VHF Radio Equipment

4. Radar

5. Electronics Workshop

6. Tool Boxes

7. Work Benches

8. Ballast Pumps and Equipment

9. Air Compressor and Hoses

10. Hydraulic Pumps

11. Scuba Diver Equipment

12. Fire Fighting and First Aid Equipment

13. Repair Parts

    Buoyancy Blocks
    Lamps
    Fuses

14. Consumables

    CO_2 Absorbent Cannisters
    Rags
    Lubricants
    Diesel Fuel
    Ballast
    Batteries

15. Marker Buoys and Transponders

16. Flags, Pennants, Shapes, etc.

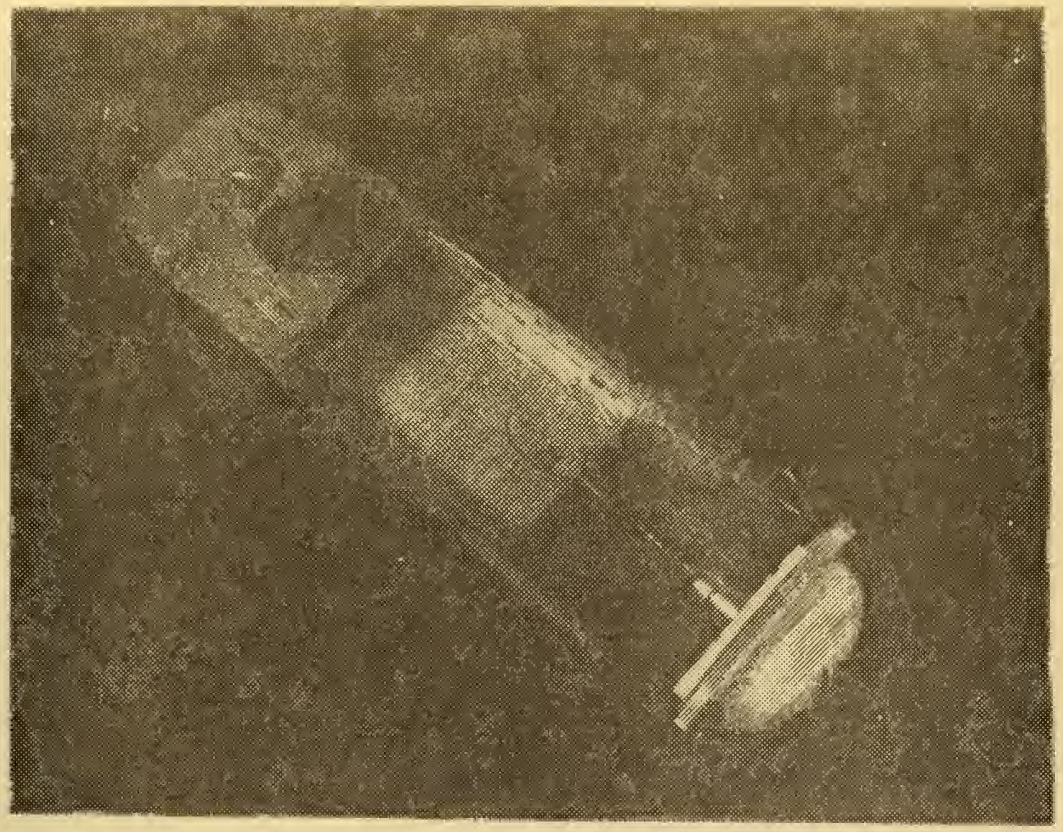


FIGURE 10. MODEL OF LCSS WITH LOCKING DEVICED COCKED

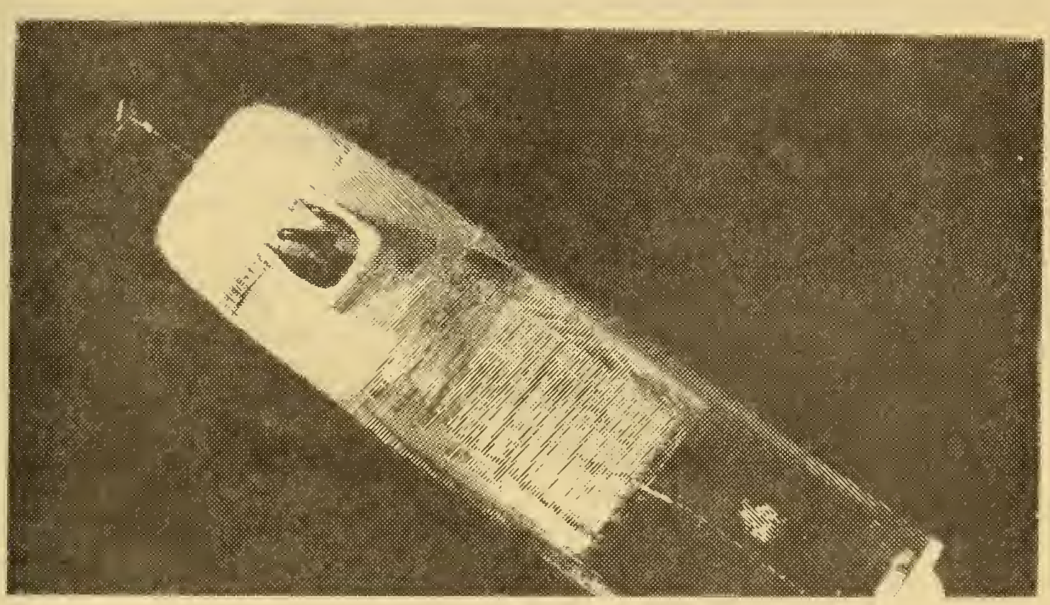
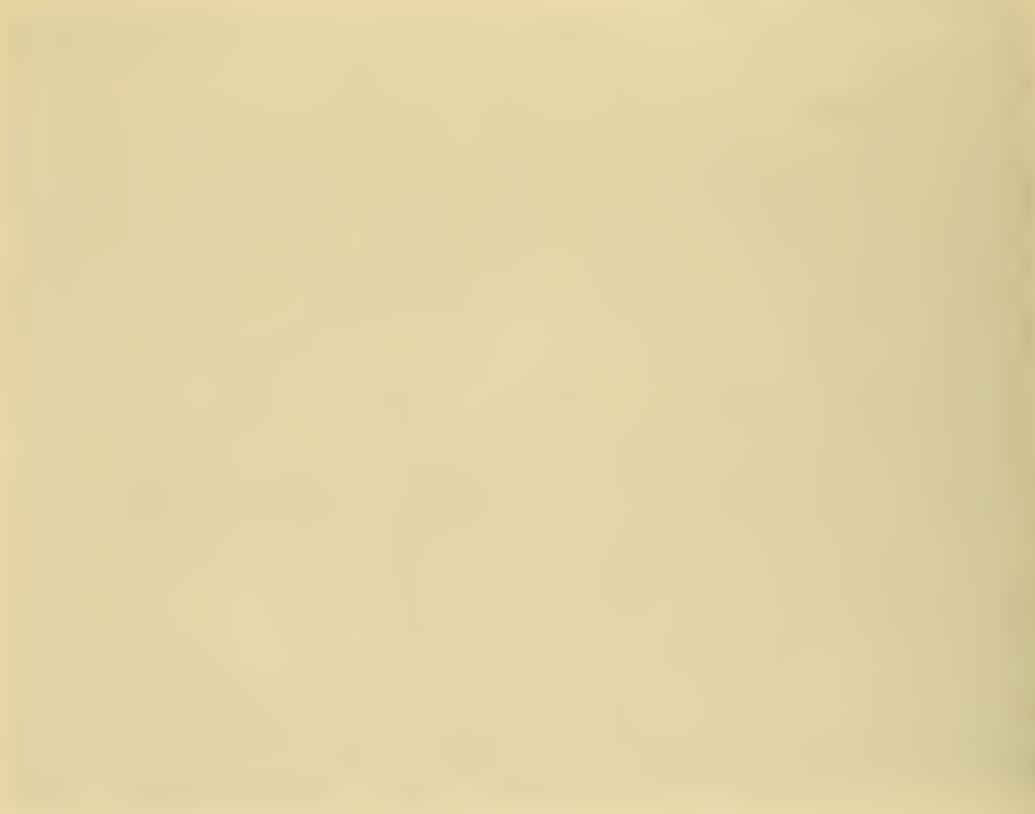
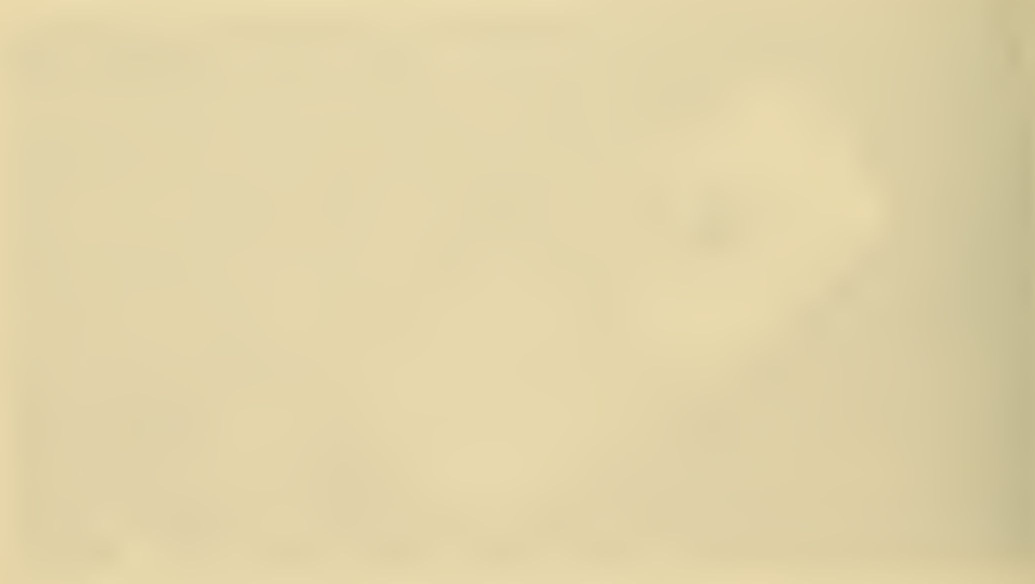


FIGURE 11. MODEL OF LCSS WITH LOCKING DEVICED TRIGGERED





Components of the locking device include: a rubber bumper, locking piston, spring, trip latch and trip rod. When the locking piston is retracted into the rubber bumper, the trip latch retains the piston in the cocked position. When the trip rod is actuated by hitting the stern of the submersible, the spring forces the locking piston forward into the receptacle on the submersible and draws the two craft firmly together. To separate the two models, the wire inside the LCSS is retracted to cock the locking piston. All logistic support can now be accomplished directly over the decks of the two craft.

b. Shock Mitigation

The coupling system would be subjected to motion in six degrees of freedom, but, ideally all accelerations would be small during any mating operation. The hydrodynamic force of the submersible stern section would provide drag to hold its bow into the waves. The LCSS would be able to use its two diesel engines to minimize surge, yaw and sway accelerations. The rubber bumper would be filled with salt water by a fire pump to provide a shock mitigation system. Figure 12 illustrates the interaction of a distributed force on the bumper being dissipated via a nozzle to the atmosphere. If the relief nozzle is secured when the LCSS is coupled, additional tensioning of the locking piston is performed when the pump pressurizes the bumper. A dynamic system could be designed to maintain a specific range of tension forces acting on the locking piston by adding or venting water pressure within the bumper. Should supplemental fastening between the two craft be required during high seas or during transit, bolts would be mechanically installed at the bumper boundary.

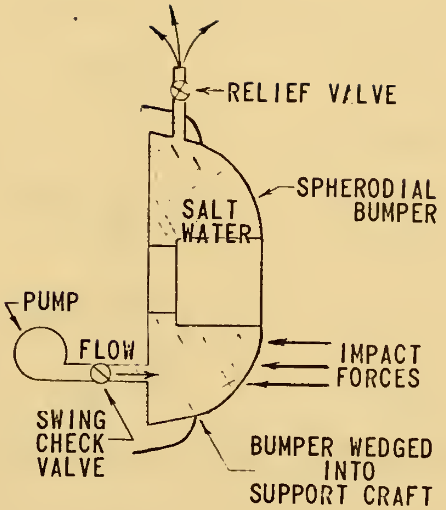


FIGURE 12. SHOCK MITIGATION BUMPER SKETCH

c. Coupling Strength

A critical step in design analysis is to estimate the maximum wave-induced forces that could be anticipated at the intersection of the two craft. Table VIII lists a summary of rudimentary calculations for shear and bending moments. The calculations were considered for concentrated loads of fifty tons acting twenty-five feet on either side of the coupling. The coupled unit is considered to approximate a hollow tube of 100 feet total length. The assumption is made that material continuity exists throughout the cylinder. The rubber bumper represents a prolate spheroid with the major axis of 12 feet and a minor axis of 8 feet, giving a surface area of approximately 265 square feet.

TABLE VIII

SHEAR AND BENDING MOMENTS RESULTS

Wave Condition	Sketch	Shear (tons)	Bumper (tons	Moment (ft-ton)
HOGGING		+50	0.38	+625
SAGGING		0	0.0	-625
FREE END		50	0.38	+402

The values in this table (which are over estimated by perhaps a factor of four) point out the necessity for substantial strength in the members that hold the joint together.

d. Advanced Coupling Proposals

After installation and testing of the prototype coupling designs in the readily adaptable landing craft, the support craft would be given an opportunity to prove its operational value. Establishing the feasibility of this type of support craft would open the way toward building a specific surface boat designed to provide submersible logistic support. For the advanced mating designs, it is proposed that efforts be made to use a tubular interconnection to permit a dry passage between the mated combination. In Figures 13 and 14 the top and side views, respectively, of a hollow locking piston show how the tubular interconnection might be achieved. Table IX lists some of the items that could be exchanged via the dry passage interconnection. Investigations into still more advanced submarine support craft could be initiated.

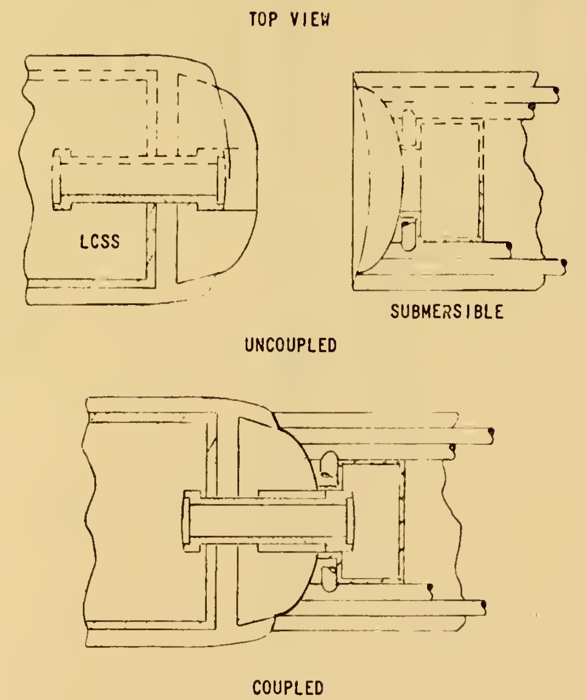


FIGURE 13. MATING SEQUENCE TOP VIEW

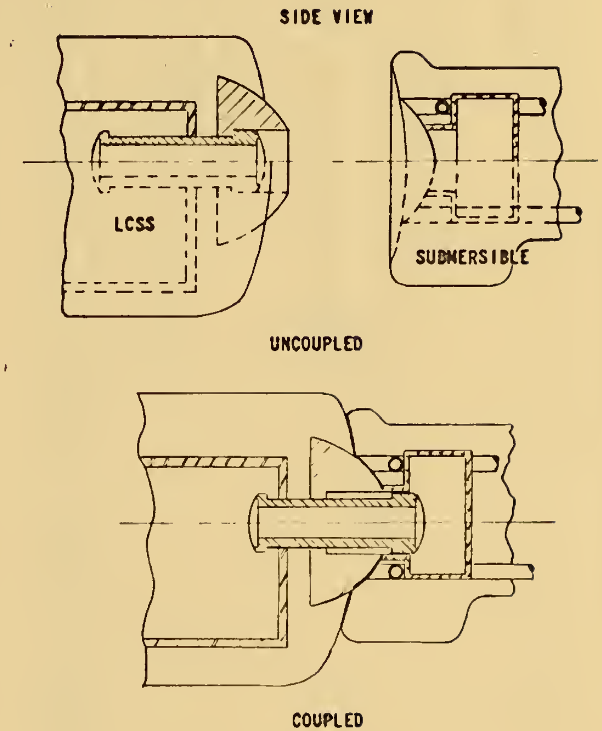


FIGURE 14. MATING SEQUENCE SIDE VIEW

TABLE IX

SERVICING SYSTEMS

HOLLOW COUPLING MECHANISM

1. Cables

   a. Battery Charging
   b. Auxiliary Power
   c. Instrument Monitoring and Testing

2. Life Support Replenishment

   a. Oxygen
   b. CO_2 Scrubbers
   c. Fresh Water
   d. Sanitation Facilities

3. Air Conditioned, Dehumidified Air to Cool Electronic Equipments While on Standby and in Checkout Phases of Submersible Predive Situation

4. Consumable Fluids

   a. Hydraulic Oil
   b. Silicone Oil
   c. Compensating Oil

5. Ballast Transfer

6. High Pressure Air

   a. Pneumatic Tool Operation
   b. Air Bottle Recharging

7. Sound Powered Phone Communication Lines

8. Fire Fighting

   a. Foams
   b. CO_2
   c. Salt Water

9. Personnel Ingress/Egress

A first step in testing the submarine support craft idea might be to modify a recently decommissioned diesel submarine. Figure 15 compares the profiles of an SS416 class diesel submarine with one modified to include a submersible locked into place at frame 40.

Arguments for or against this idea hinge on the relatively high cost of maintaining the submarine. To counter the expense of keeping the submarine certifiable to dive, one could permanently surface the vessel or limit its dives to 50 feet. The reduction from a wartime crew to a submersible support ship crew would reduce costs and provide adequate hotel facilities and support systems ready for immediate utilization. From an organizational standpoint, the submarine force would have complete control over both craft and would not have to worry about interface problems realized between surface and submarine sailors. The surface support craft, still a major component of the concept, would be used when the submersible was flown to remote areas or when the support submarine was drydocked.

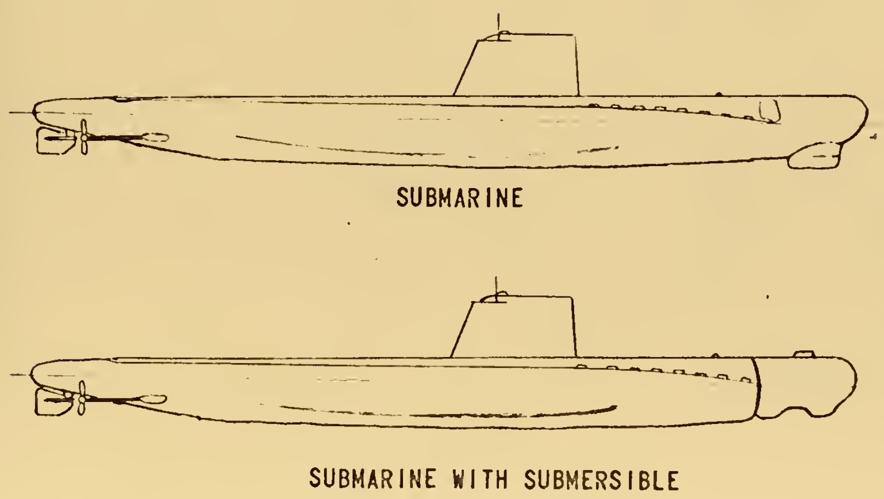


FIGURE 15. SUBMARINE PROFILES

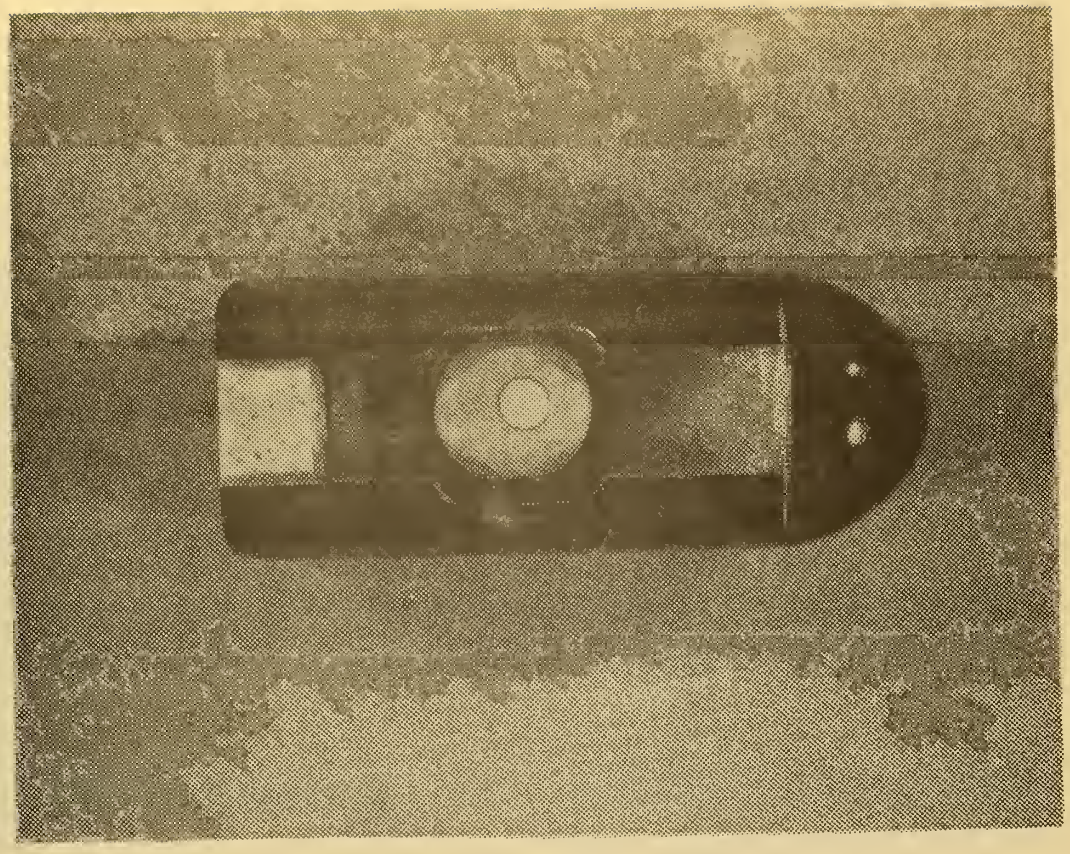


FIGURE 16. MODEL OF SUBMERSIBLE

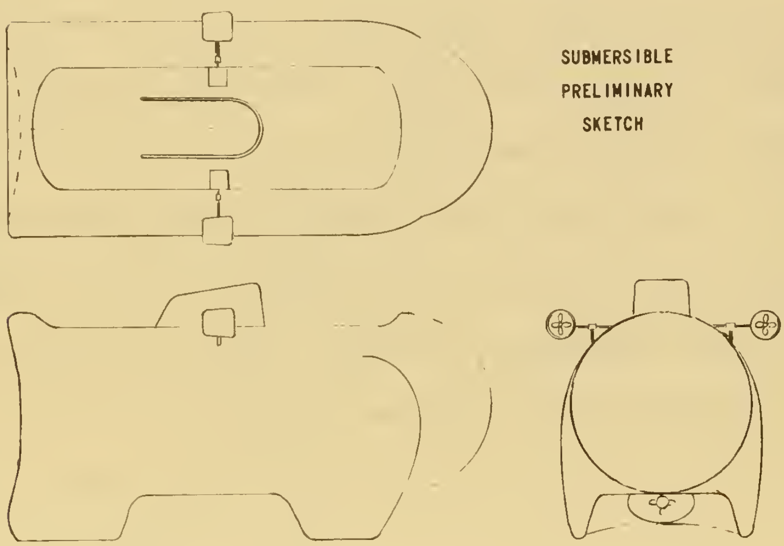


FIGURE 17. SUBMERSIBLE PRELIMINARY SKETCH

C. SUBMERSIBLE DESIGN

1. Objectives

Considering the preceeding paragraphs of Section III, two design parameters, the use of a solid floatation material and the coupling of support and submersible craft, have been established. Additional design parameters such as hull shape and weight distribution were based on work done by Green [Ref. 11]. Guided by those parameters, the submersible pictured by the model in Figure 16 evolved from the preliminary sketch shown in Figure 17. This design is expected to perform more tasks over a broader spectrum of potential missions and yet be more economical to support logistically.

2. Shape and Dimension

The basic shape approximates ideal streamline shape. The elliptical cross-section with its major axis parallel to the water surface provides increased roll stability and more desirable towing characteristics. The twelve foot beam by ten foot height dimensions were chosen to fit through an aircraft cargo hatch. The overall length of forty feet was selected preliminary weight and buoyancy estimates for a submersible capable of descending to depths greater than 20,000 feet.

A compromise to the streamline body is the cut-off stern section used for the coupling mechanism. Available experimental data on projectiles and fuselages with one flat end are described in the following relationship taken taken from Hoerner [Ref. 16].

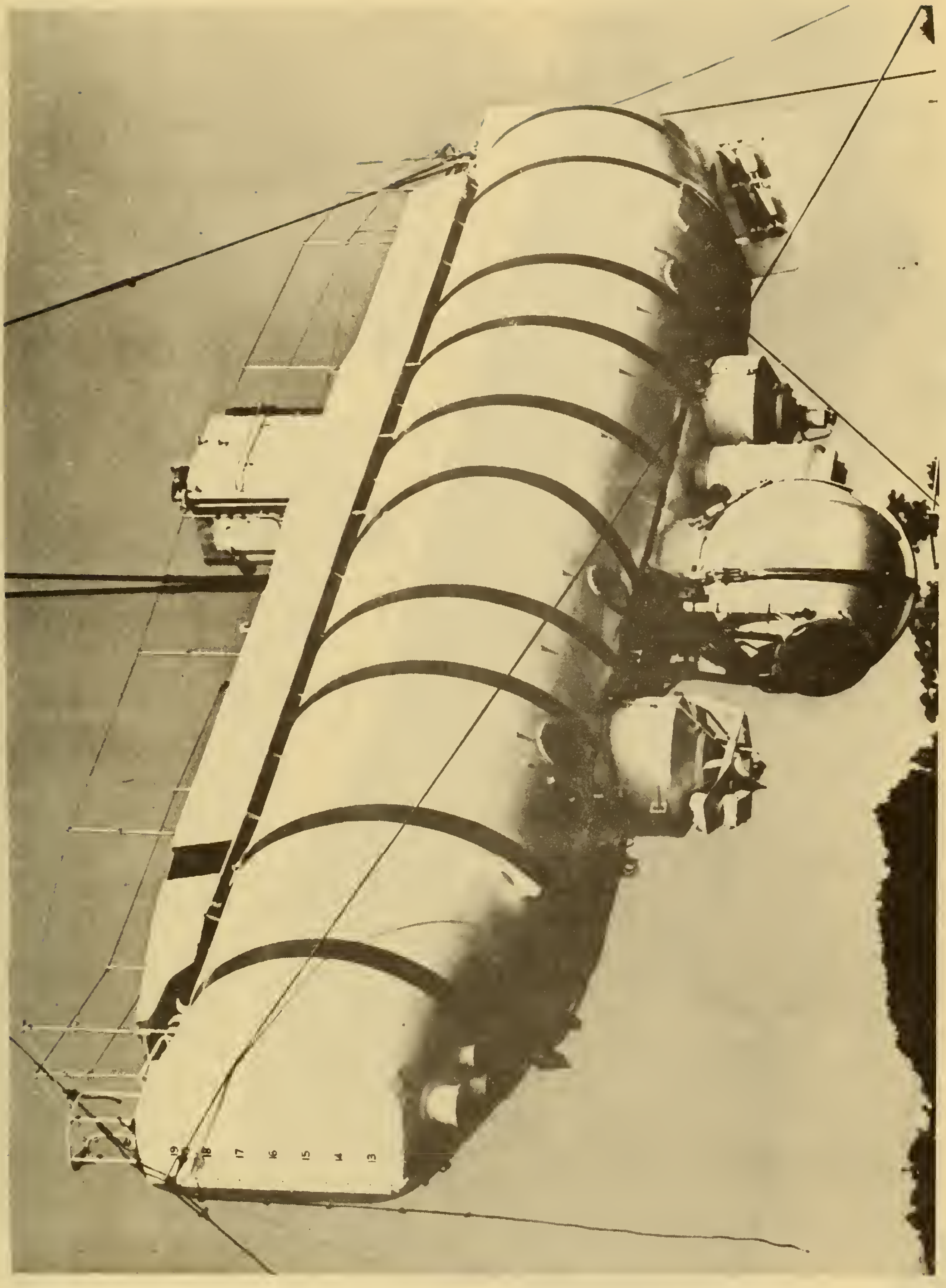
$$C_{DB} = 0.029 \left[\frac{dB}{d}\right]^3 \Big/ \sqrt{C_{FB}}$$

dB = diameter of the base

d = maximum diameter of vehicle

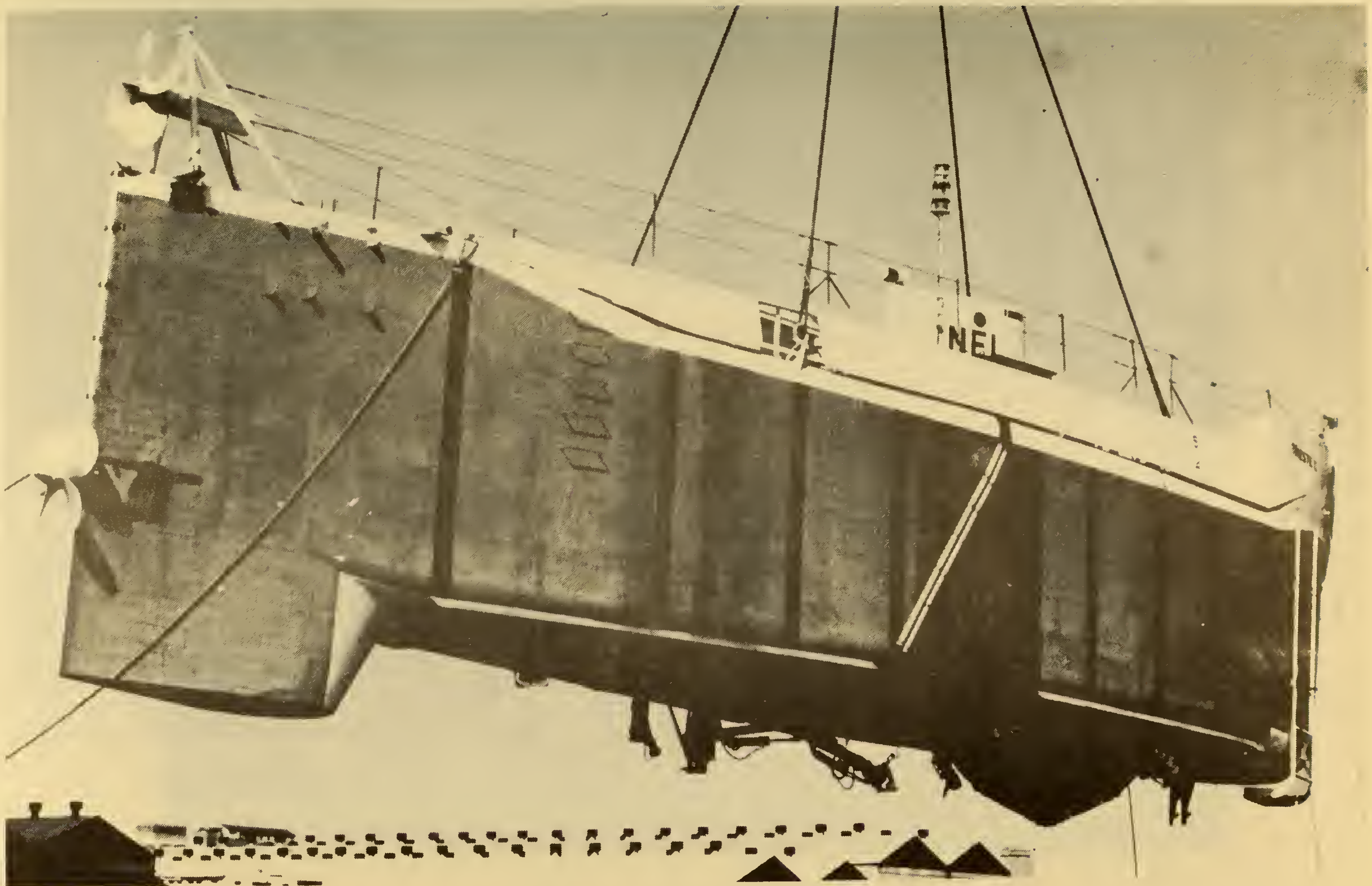
C_{DB} = coefficient of base drag

C_{FB} = coefficient of fore body drag



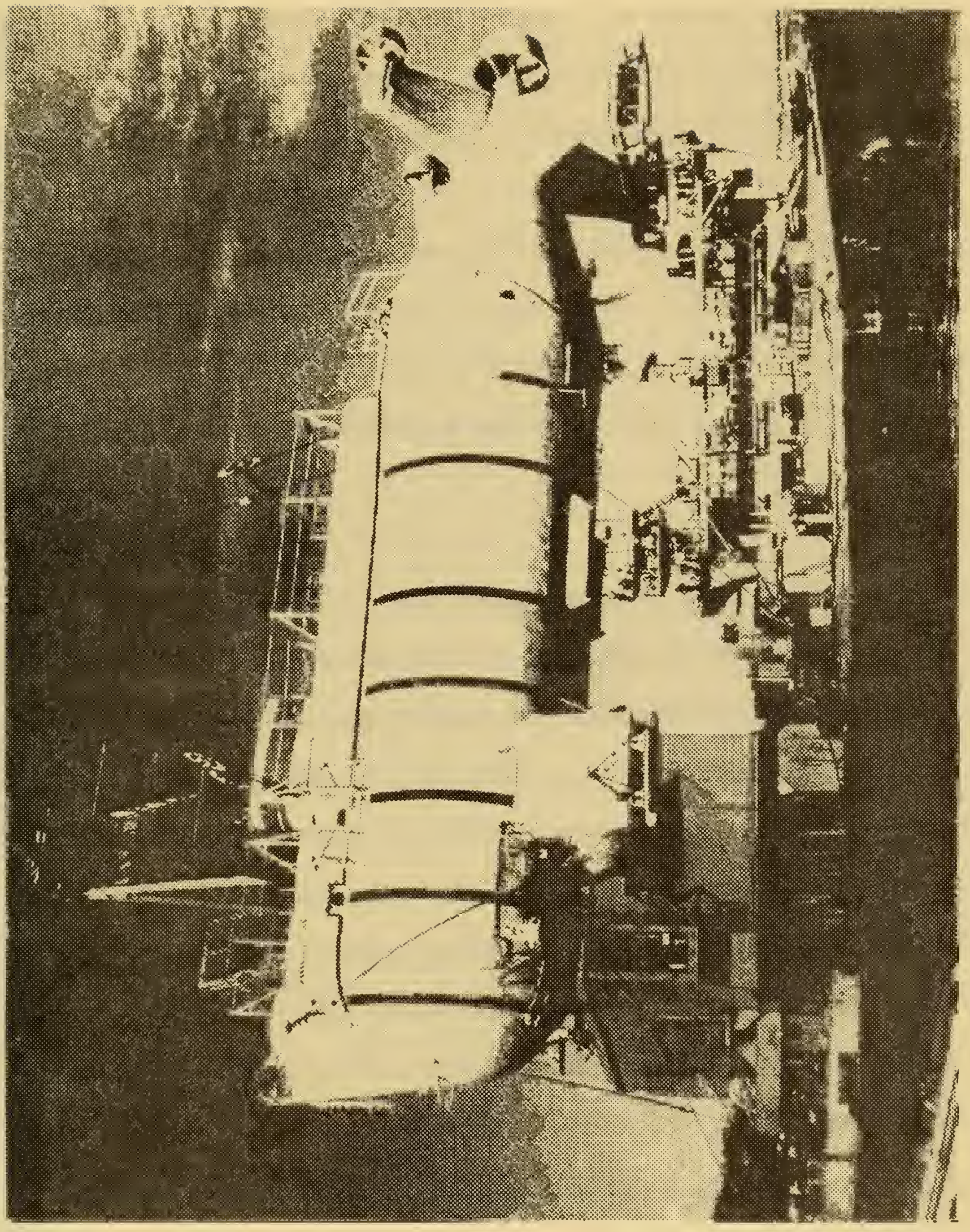
U.S. NAVY

FIGURE 18. TRIESTE I



U. S. NAVY

FIGURE 19. TRIESTE II



U. S. NAVY

FIGURE 20. TRIESTE (DSV-1)

Noting the configurations of the deep diving bathyscaphes of Figures 18 through 20, a modest $C_{FB} = .18$ is assumed to account for surface irregularities and protuberances. Assuming the maximum of $^{dB}/d = 1$, the reference equation indicates a base drag of $C_{DB} = 0.07$, a comparatively small number which is on the order of 9% of the total hull drag.

The skegs are extensions of the keel used to provide vehicle support when it is set down out of the water. They act as skis for landing on the ocean's bottom, as bumper parts for underwater obstacles which could scrape the vehicle's belly and also act to retard yaw, roll, and sway accelerations.

3. Propulsion

While operating in the water column or on the surface, the submersible will want to be able to use maximum speed and control if required. However, on the bottom, the submersible requires vertical and horizontal control with the ability to creep at speeds, generally less than two knots to be able to see what passes beneath. An externally mounted electric motor system which has proven itself on NR-1 and other vehicles would be positioned under the coupling mechanism. The motor would be part of an active rudder system surrounded by the stern skegs. To provide rudder controls, another motor or a hydraulic system would be used. The stern motor would provide the major propulsion requirements.

Two smaller motors (noted Figure 17, but absent from the model of Figure 16) provide supplemental submerged propulsion and the fine control propulsion for bottom maneuvering. The two smaller motors are located high on the hull to either side of the center axis. The location of these motors reduces turbulence on the bottom which stirs up clouds

of silt which may reduce visibility enough to stop operations. The two smaller motors rotate 90° from vertical to horizontal which, with forward and reverse controls, provide a wide range of attitude control near the bottom. To prevent damage to the motors while on the surface, they could be folded into the sail area for protection. Ducted propellers or tandem propellers are alternate propulsion methods which provide high efficiency.

4. Elevator Platform

A means for exposing instruments, tools, cameras, lights and cabin windows to the area of interest has to be provided. Referring to the pictures of TRIESTE (Figures 18 through 20), note that, in general, equipments of this type are placed external to the hull. When the submersible is on the surface, the equipment remains submerged, being continually subjected to corrosion and wave action. This fact is the cause of many material failures mentioned in the introduction. An elevator platform which can raise and lower from the keel is expected to alleviate this problem. The platform will contain the majority of equipment used to obtain information. An advantage to the elevator is that it can be lowered partially when approaching bottom and still be protected by the skegs or it can be lowered completely to provide unhindered visibility when operating near the bottom.

When the submersible is surfaced with the elevator in the raised and locked position, all equipment on the platform would be in a dry working space, thus eliminating many of the SCUBA-trained technician requirements. Equipments that remain submerged on other submersibles would be accessible for maintenance and protected from wave forces.

The platform elevator concept introduces several engineering design requirements, such as watertight seal at the platform interface with the keel, a hydraulic control system for elevator, pumping or blowing systems for water removal, and a wiring harness to provide electrical continuity between equipment on the platform and power source within the float. Time permitted only a brief investigation into the feasibility of these requirements. In one fashion or another, similar situations have been satisfactorily dealt with, such as hatch seal between the sphere and the float on bathyscaphes, the elevator systems for oil rigs and the ASR-21, the ballast control of submarines, or the wiring harness that moves up and down on submarine snorkel masts.

There are several other advantages to the elevator. When it is retracted, instruments no longer protrude to spoil streamlining or exist as fragile extensions which may foul on cables or other objects. The relatively unobstructed space above the equipment in the elevator platform permits interchangeability. For example, a new or up-graded personnel sphere could be positioned and plugged into existing penetrator leads with little or no shipyard time or facilities required. Reballasting of the solid floatation modules would be routine without a complete dismantling of the superstructure. Figure 21 shows the model with the elevator platform in the lowered position beneath the submersible.

5. Basic Framework

A method to distribute the loads acting on the submersible must be outlined. Literature provides little insight into the structural aspects of hydrospace vehicles aside from pressure hull considerations or outer shell fabrication. The approach selected for building the framework was to use the simplest design that could do the job. A truss of hollow pipes to achieve the best strength ratio is sketched in Figure 22.

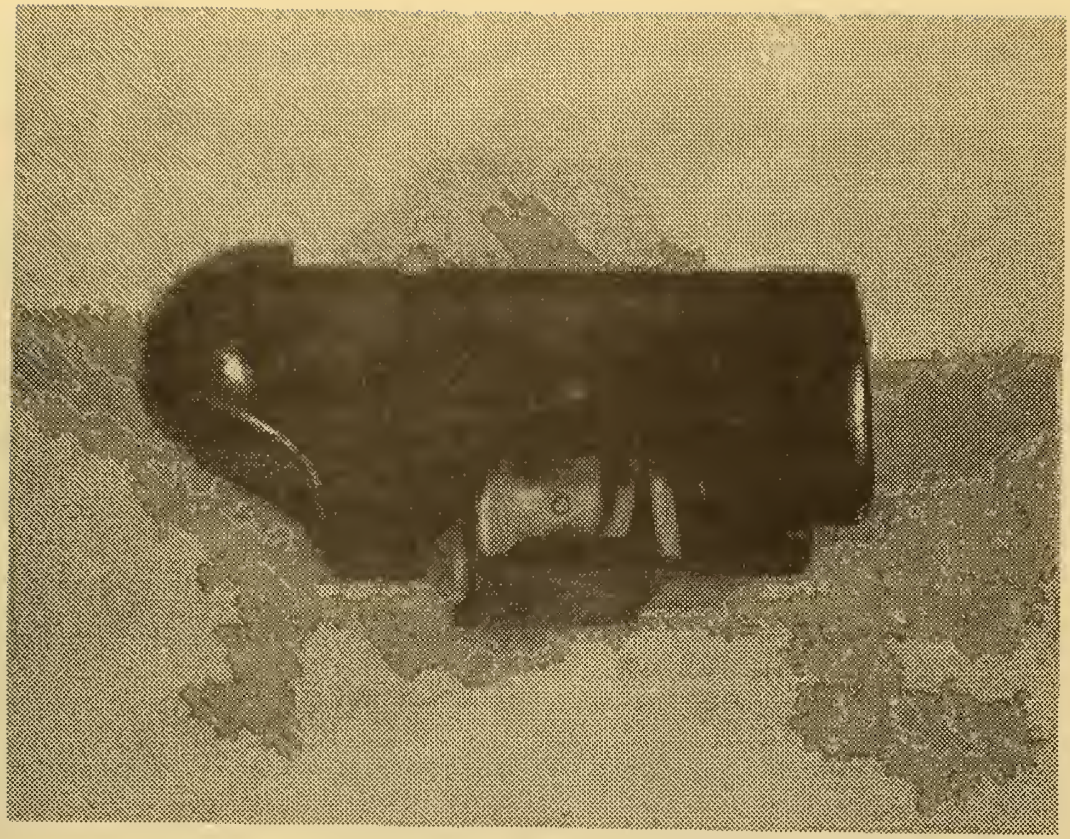


FIGURE 21. SUBMERSIBLE MODEL WITH ELEVATOR LOWERED

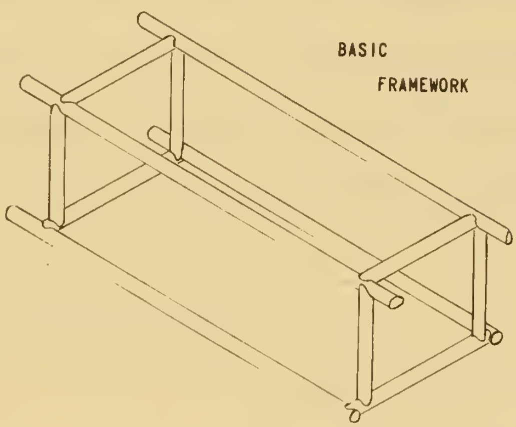


FIGURE 22. BASIC FRAMEWORK

This sketch is used only to outline the skeleton and not meant to imply any specific materials or means of fabrication.

A discussion of the various design proposals and how they integrate into the basic framework is now considered. The keel in the vicinity of the elevator platform requires an open area and room for a hoisting mechanism that can transmit its load directly to the frame. The buoyancy module blocks of floatation material must be supported in a vertical plane for upward buoyancy forces when submerged or downward weight forces when surfaced. Figure 23 suggests how this would be achieved. The stern coupling mechanism should lock directly to the frame as well as other components subject to high force such as the lifting and towing and the skegs. Figure 24 contains the additional structural members for these stipulations. The addition of an elevator platform is sketched in Figure 25.

The hollow pipes could contain the compensating oil reservoir. A compressible oil is necessary to compensate for the increasing buoyancy with depth of syntactic foam. The two top longitudinal pipes could serve as a stowage tube for rams that could be extended ahead of the submersible. The leading tip of the ram could have lights and cameras to extend the field of vision, thus increasing operating efficiency and safety.

6. Additional System Component

The component design of the support craft and submersible leads to the possibility of coupling a third module to either of the original craft. The third module could be used to transport objects through the water column between the ocean's surface and bottom. Heavy objects which could not be handled by a mechanical arm could be transported in a third module by remote ballasting control from the submersible.

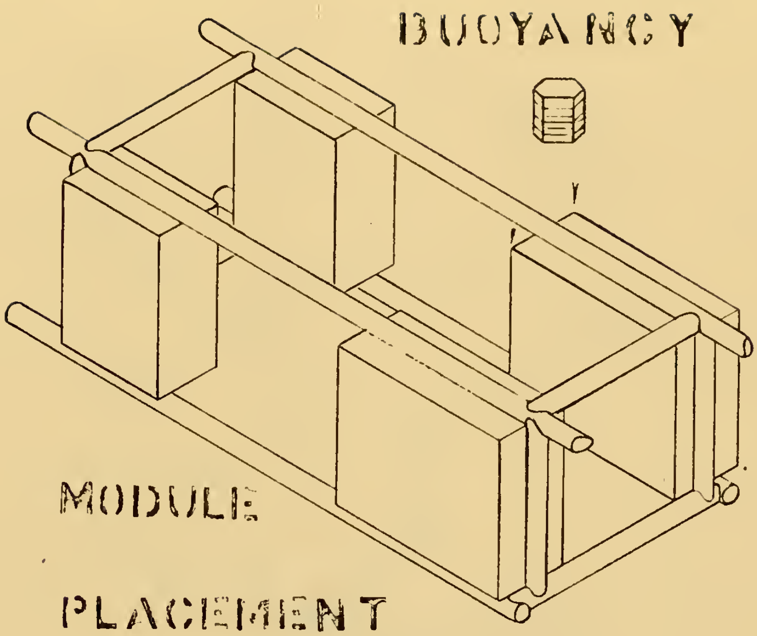


FIGURE 23. BUOYANCY MODULE PLACEMENT

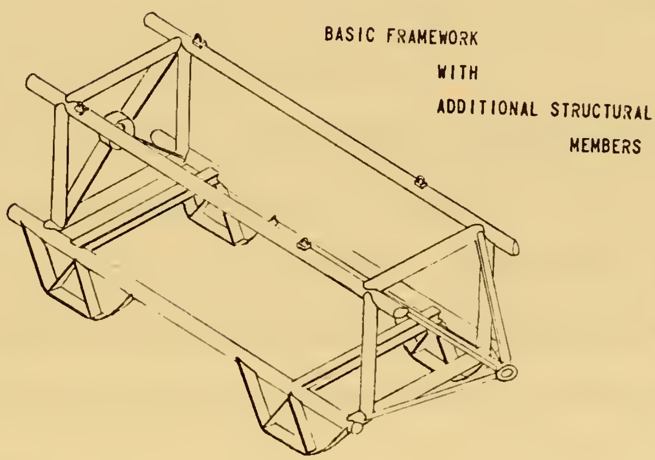


FIGURE 24. BASIC FRAMEWORK WITH ADDITIONAL STRUCTURAL MEMBERS

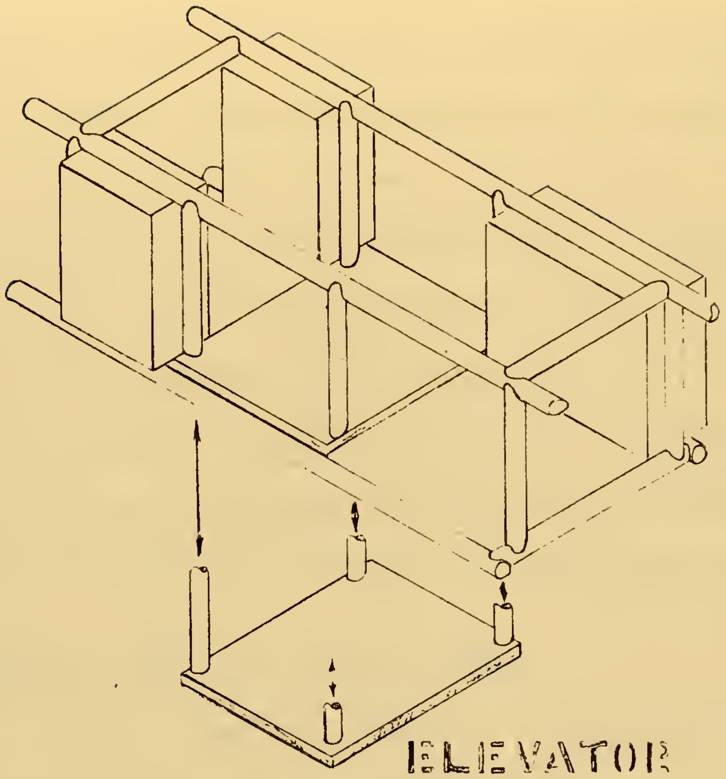


FIGURE 25. FRAMEWORK WITH ELEVATOR

If the transported object were a pontoon, the submersible would preposition it alongside a sunken object, attach lines from the pontoon to the object, then manipulate the pontoon to jettison ballast and the object would be lifted to the surface. Floatation aboard the pontoon would be the syntactic foam buoyancy modules.

Another example would be a cargo module containing data collection instruments or sonar hydrophone arrays precisely positioned by the submersible on either covert or overt mission. Weeks later, the submersible would return to the site, couple with the cargo module, and retrieve them. If the cargo module contained a diving bell or a rescue chamber, it would serve to transfer men or material between the surface layers and the deep depths. Once in place, the rescue chamber could return to the surface without assistance of the submersible, thus another

rescue module could be positioned on a stricken submarine immediately after the preceding rescue module commenced its ascent to the surface.

An infinity of missions never before possible can be imagined with the utilization of the cargo module idea. It might even be the forerunner of the submarine method used to transport oil. Submarine tankers have been proposed, but why waste the time of a ship and crew when a string of oil tank modules could be filling at the ocean bottom well head or be emptying at the refinery site while the submersible moves the tank modules from well to refinery and back.

D. OPERATIONAL TESTING OF COMBINED MODELS

Constructing the coupling device to be used with the model LCSS took longer than expected. Due to insufficient time for equipment set up, observation of LCSS and submersible response to wave tank motions was not conducted. A successful bathtub test of the complete model pictured in Figure 26 proved that mating was possible in turbulent, hand-generated conditions. The draft of the LCSS was varied by adding weights to cause an alignment mismatch between the mating craft. In calm water conditions, a variation of several feet could be a problem, but it is doubtful that an experienced seaman would load his vessel to the extent that he had little freeboard and could easily be swamped.

An alternate testing method by using the graphic display unit of the IBM 360 computer also failed to materialize. The six month interval required to mail order an IBM operations manual, plus the additional time required to program wave conditions and various vehicle parameters, was not available.

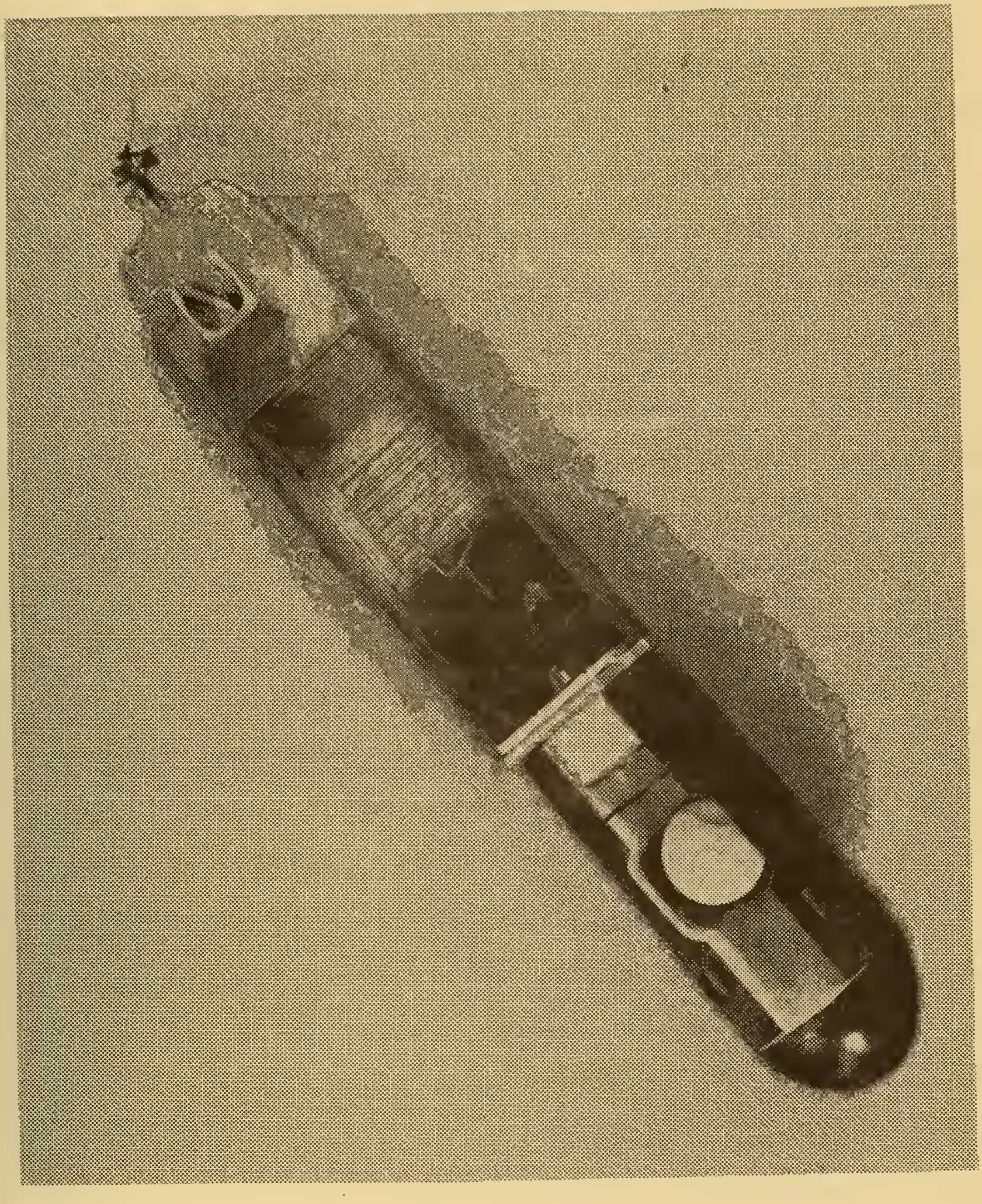


FIGURE 26. COUPLED LCSS/SUBMERSIBLE MODEL

IV. INTERPRETATION OF RESULTS

A. RESULTS OF COMPONENT INVESTIGATIONS

The results of the experiments with porcelain sphere manufacturing and pressure testing suggest that a two inch diameter sphere with desirable specific gravity and strength characteristics for 20,000 foot buoyancy can be produced. Three inch diameter sphere received detrimental flaws during the firing process. These facts imply that a porcelain sphere with a diameter between two to three inches exists that could be manufactured without introducing a flaw. Improved mechanization and processing techniques would lead to producing this sphere with predictable properties including a uniform shell thickness.

The results of calculations to determine dimensions and buoyancy of a sphere-syntactic foam module suggests that such a conglomerate would be advantageous compared to the utilization of syntactic foam alone. Using the porcelain spheres discussed in the preceding paragraph, the sphere-foam conglomerate would be strong enough to provide safe supplemental buoyancy at 20,000 foot ocean depths.

A scale model assembly of the modified landing craft and bow locking device illustrated a possible approach to investigation of a new mating concept. A scale model assembly of a submersible designed to accommodate solid floatation material, a stern mating mechanism and hull streamlining features illustrated a possible approach to standardization in future submersible construction. The coupled support craft and submersible

models illustrate an approach to solving severe logistic servicing problems by eliminating the water gap and relative motions which separate such systems today.

Considering all these interpretations in summary leads to the final results which follow in the next section.

B. FINAL RESULTS

The final result of this thesis is a design concept using coupled components to solve deep submergence logistic problems. In Figure 27, a sketch of the design concept using rectangles to represent the components summarizes the results. In anticipating the needs of the oceanographic decade ahead, this thesis submits a new approach to meet the goals of the 1963 Deep Submergence Systems Review Group. The final result of this thesis is a design concept which could develop into a totally submerged search and recovery system which could operate to depths of 20,000 feet.

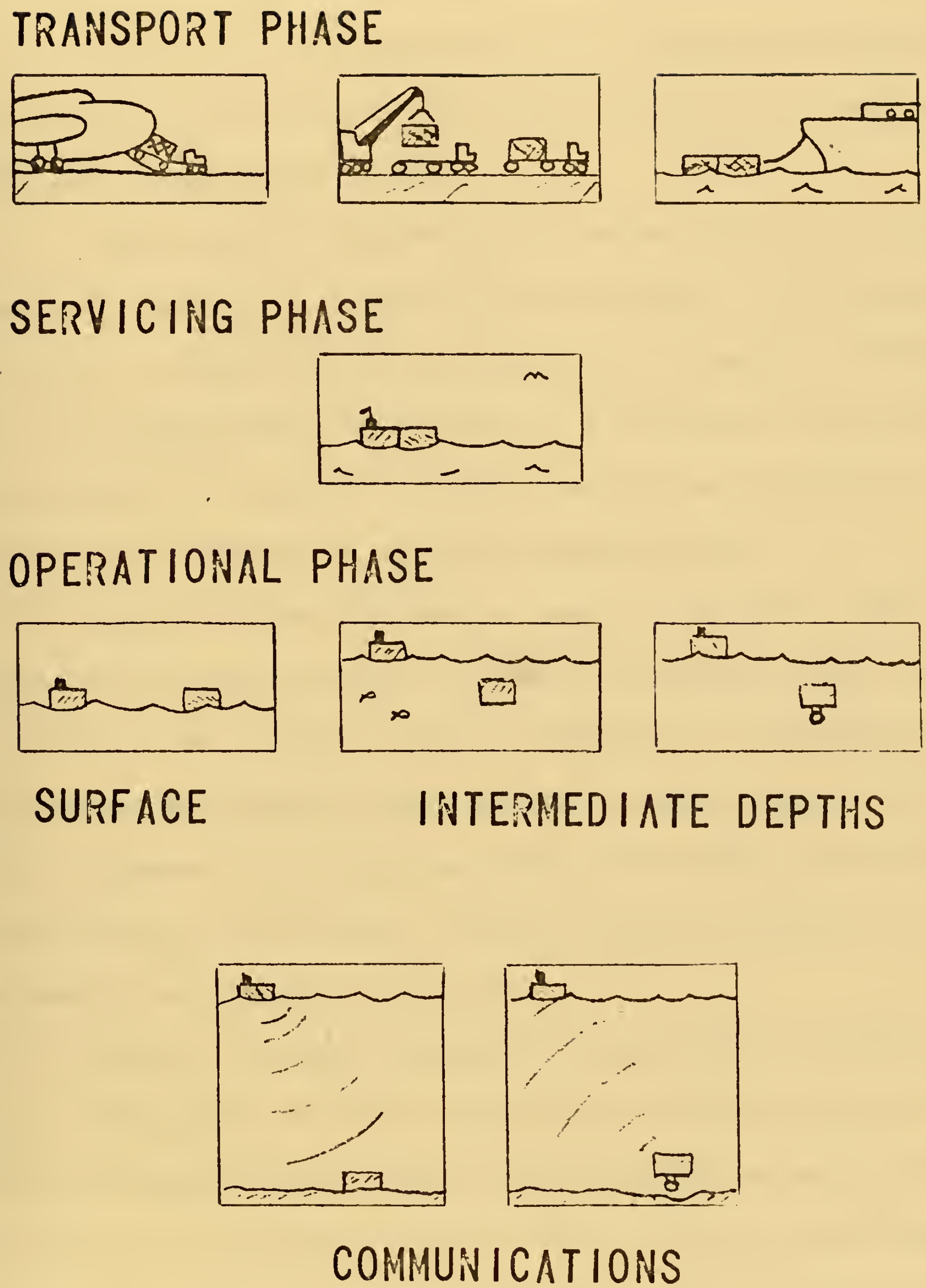


FIGURE 27. DESIGN CONCEPT

V. RECOMMENDATIONS FOR FUTURE WORK

The temptation to list generalized and grandiose recommendations is relinquished in favor of providing several worthwhile extensions of the thesis that require more support.

1. Investigate the optimum spacing between spheres to prevent sympathetic implosion. A paper by Lord Rayleigh, "On the Pressure Developed in a Liquid during the Collapse of a Spherical Cavity", [Ref. 17] suggests that the pressure at a relatively moderate distance from the shell of the cavity can be calculated on the basis of sphere radius and coefficients of material compressibility.

2. Program the IBM 360 computer graphic television display to generate ocean wave conditions. Using the generated waves, superimpose the models of the support craft and submersible to determine optimum displacement and dimension characteristics of the mating of the two craft. Determine the maximum sea state and maximum forces that could theoretically be encountered. Film the various situations for presenting the results and comparing the data.

3. Design a sea-going locking device to support the Naval Postgraduate School Submersible SEA OTTER. Depending on time and money, the project could be extended through actual construction in the machine shop and bay trials. The SEA OTTER would not have to be dive operational, but, once the support system was available and proven, it would help justify making SEA OTTER a working laboratory for oceanography-oriented students.

4. Designs of any specific system described in the paper, such as the hydraulic elevator system, the stern coupling mechanism, the extendable light and camera boom, the elevator wiring harness, the compensating oil system, mechanical arm installation, etc. offer a challenge to any engineering-oriented student.

5. Develop a tactical doctrine that the LCSS and submersible would use during the mating sequence. Should a diesel submarine be used for the support ship, adapt the MK 101 Fire Control System for use as a submersible tracking and recovery system.

VI. CONCLUSIONS

The measurements made on porcelain sphere strengths and associated computations indicate that a high strength buoyancy material made of such spheres embedded in syntactic foam would be feasible and an advantageous substitute for fluid buoyancy materials.

A coupled modular combination of deep submersible and support craft appears to be a practical solution to the present severe logistic problems which now attend deep submergence operations.

The components of the proposed design concept, taken together or independently, in future submersible construction will improve efficiency, improve current methods of transporting, maintaining and operating, improve safety, improve working conditions, eliminate unnecessary work, and very important, reduce overall costs.

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	3.55	469.0	50.5	75.0	24.6
0.2	3.98	374.6	57.2	75.2	18.0
0.3	4.41	305.7	61.6	75.2	13.5
0.4	4.83	254.8	64.9	75.3	10.5
0.5	5.26	214.6	66.9	75.1	8.2
0.6	5.68	183.7	68.5	75.1	6.6
0.7	6.11	159.0	69.8	75.2	5.4
0.8	6.53	139.8	71.1	75.6	4.5
0.9	6.96	122.3	71.4	75.1	3.7
1.0	7.39	109.3	72.4	75.5	3.1
1.1	7.81	98.1	73.2	75.8	2.7
1.2	8.24	89.2	74.3	76.6	2.3
1.3	8.66	79.0	73.2	75.1	1.9
1.4	9.09	71.8	73.5	75.2	1.7

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	6.68	134.3	46.6	76.0	29.4
0.2	7.11	117.4	50.6	75.1	24.5
0.3	7.53	104.5	54.1	75.1	21.0
0.4	7.96	94.2	57.7	75.6	18.0
0.5	8.39	85.0	60.2	75.7	15.5
0.6	8.81	76.9	62.0	75.6	13.6
0.7	9.24	70.4	64.1	76.1	12.0
0.8	9.66	65.6	67.0	77.6	10.6
0.9	10.09	60.3	68.2	77.8	9.6
1.0	10.51	54.5	68.2	76.3	8.2
1.1	10.94	50.9	69.8	77.2	7.4
1.2	11.37	46.9	70.3	76.8	6.5
1.3	11.79	42.6	69.3	75.0	5.7
1.4	12.22	40.9	71.9	77.4	5.5

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	9.81	63.6	45.3	77.6	32.3
0.2	10.24	57.3	48.5	76.0	27.6
0.3	10.66	53.3	52.0	76.8	24.8
0.4	11.09	49.0	54.2	76.3	22.1
0.5	11.51	47.4	58.4	79.6	21.2
0.6	11.94	42.5	58.2	76.7	18.5
0.7	12.37	40.5	61.8	78.4	16.5
0.8	12.79	38.3	63.6	79.3	15.7
0.9	13.22	35.9	65.7	79.4	13.8
1.0	13.64	33.4	65.7	78.6	13.0
1.1	14.07	30.6	65.8	76.8	11.0
1.2	14.49	31.4	72.7	83.7	11.0
1.3	14.92	28.5	70.0	80.2	10.2
1.4	15.35	25.3	67.2	75.4	8.3

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	36.9	45.6	78.2	32.7
0.2	13.37	34.2	46.6	77.3	30.7
0.3	13.79	31.3	49.2	75.3	26.1
0.4	14.22	32.1	56.0	82.2	26.1
0.5	14.64	28.9	54.4	78.5	24.2
0.6	15.07	29.7	61.1	85.3	24.2
0.7	15.49	26.2	60.1	79.7	19.6
0.8	15.92	26.9	66.6	86.2	19.6
0.9	16.35	23.2	60.8	78.4	17.6
1.0	16.77	23.7	66.9	84.5	17.6
1.1	17.20	24.3	73.3	90.9	17.6
1.2	17.62	20.2	66.5	79.5	13.1
1.3	18.05	20.7	72.3	85.4	13.1
1.4	18.47	21.2	78.4	91.4	13.1

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	507.0	70.2	75.1	4.9
0.2	3.98	404.3	71.5	75.1	3.6
0.3	4.41	329.8	72.4	75.1	2.7
0.4	4.83	274.7	73.1	75.2	2.1
0.5	5.26	231.9	73.5	75.2	1.6
0.6	5.68	199.2	74.1	75.5	1.3
0.7	6.11	172.6	74.5	75.5	1.1
0.8	6.53	150.9	74.7	75.6	0.9
0.9	6.96	132.4	74.5	75.2	0.7
1.0	7.39	118.2	75.0	75.6	0.6
1.1	7.81	105.5	75.0	75.5	0.5
1.2	8.24	95.0	75.2	75.6	0.5
1.3	8.66	87.1	76.3	76.7	0.4
1.4	9.09	78.2	75.4	75.8	0.3

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	143.6	69.4	75.2	5.9
0.2	7.11	127.1	70.4	75.4	4.9
0.3	7.53	114.7	72.1	76.3	4.2
0.4	7.96	102.7	72.7	76.3	3.6
0.5	8.39	91.6	72.4	75.5	3.1
0.6	8.81	83.8	73.6	76.3	2.7
0.7	9.24	75.2	72.8	75.2	2.4
0.8	9.66	70.6	75.2	77.3	2.1
0.9	10.09	62.9	73.3	75.1	1.8
1.0	10.51	59.8	75.9	77.6	1.7
1.1	10.94	53.6	73.8	75.3	1.5
1.2	11.37	49.8	74.1	75.4	1.3
1.3	11.79	48.5	77.8	79.0	1.2
1.4	12.22	44.0	75.9	77.0	1.1

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	69.1	71.6	78.0	6.5
0.2	10.24	62.9	71.7	77.4	5.6
0.3	10.66	59.2	73.8	78.9	5.1
0.4	11.09	55.0	74.7	79.3	4.6
0.5	11.51	50.5	74.5	78.5	4.1
0.6	11.94	45.7	72.8	76.4	3.6
0.7	12.37	43.7	75.0	78.4	3.4
0.8	12.79	41.6	76.8	79.9	3.1
0.9	13.22	39.4	77.7	80.6	2.9
1.0	13.64	36.9	78.0	80.5	2.6
1.1	14.07	34.3	77.1	79.5	2.4
1.2	14.49	31.4	75.4	77.5	2.0
1.3	14.92	32.3	82.2	84.2	2.0
1.4	15.35	29.2	78.7	80.6	1.9

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	40.5	72.7	79.6	6.9
0.2	13.37	37.9	73.3	79.4	6.1
0.3	13.79	35.1	72.6	78.3	5.7
0.4	14.22	32.1	71.2	76.1	4.8
0.5	14.64	32.9	77.9	82.8	4.8
0.6	15.07	29.7	74.5	79.0	4.5
0.7	15.49	30.4	81.1	85.6	4.5
0.8	15.92	26.9	76.2	79.9	3.6
0.9	16.35	27.5	82.6	86.2	3.6
1.0	16.77	23.7	75.0	78.3	3.3
1.1	17.20	24.3	80.9	84.2	3.3
1.2	17.62	24.8	87.2	90.4	3.3
1.3	18.05	20.7	76.6	79.0	2.4
1.4	18.47	21.2	82.3	84.7	2.4

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	469.0	68.7	75.0	6.4
0.2	3.98	374.6	70.5	75.2	4.7
0.3	4.41	305.7	71.6	75.2	3.5
0.4	4.83	254.8	72.6	75.3	2.7
0.5	5.26	214.6	73.0	75.1	2.1
0.6	5.68	183.7	73.4	75.1	1.7
0.7	6.11	159.0	73.8	75.2	1.4
0.8	6.53	139.8	74.4	75.6	1.2
0.9	6.96	122.3	74.1	75.1	1.0
1.0	7.39	109.3	74.7	75.5	0.8
1.1	7.81	98.1	75.1	75.8	0.7
1.2	8.24	89.2	76.0	76.6	0.6
1.3	8.66	79.0	74.6	75.1	0.5
1.4	9.09	71.8	74.7	75.2	0.4

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	134.3	68.3	76.0	7.6
0.2	7.11	117.4	68.8	75.1	6.4
0.3	7.53	104.5	69.7	75.1	5.4
0.4	7.96	94.2	71.0	75.6	4.7
0.5	8.39	85.0	71.6	75.7	4.0
0.6	8.81	76.9	72.1	75.6	3.5
0.7	9.24	70.4	73.0	76.1	3.1
0.8	9.66	65.6	74.9	77.6	2.8
0.9	10.09	60.3	75.3	77.8	2.5
1.0	10.51	54.5	74.2	76.3	2.1
1.1	10.94	50.9	75.2	77.2	1.9
1.2	11.37	46.9	75.1	76.8	1.7
1.3	11.79	42.6	73.6	75.0	1.5
1.4	12.22	40.9	76.0	77.4	1.4

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	63.6	69.2	77.6	8.4
0.2	10.24	57.3	68.9	76.0	7.1
0.3	10.66	53.3	70.3	76.8	6.4
0.4	11.09	49.0	70.6	76.3	5.7
0.5	11.51	47.4	74.1	79.6	5.5
0.6	11.94	42.5	71.9	76.7	4.8
0.7	12.37	40.5	74.1	78.4	4.3
0.8	12.79	38.3	75.2	79.3	4.1
0.9	13.22	35.9	75.9	79.4	3.6
1.0	13.64	33.4	75.3	78.6	3.4
1.1	14.07	30.6	73.9	76.8	2.9
1.2	14.49	31.4	80.8	83.7	2.9
1.3	14.92	28.5	77.6	80.2	2.6
1.4	15.35	25.3	73.3	75.4	2.1

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	36.9	69.8	78.2	8.5
0.2	13.37	34.2	69.4	77.3	8.0
0.3	13.79	31.3	68.6	75.3	6.8
0.4	14.22	32.1	75.4	82.2	6.8
0.5	14.64	28.9	72.3	78.5	6.3
0.6	15.07	29.7	79.0	85.3	6.3
0.7	15.49	26.2	74.7	79.7	5.1
0.8	15.92	26.9	81.2	86.2	5.1
0.9	16.35	23.2	73.8	78.4	4.6
1.0	16.77	23.7	79.9	84.5	4.6
1.1	17.20	24.3	86.4	90.9	4.6
1.2	17.62	20.2	76.2	79.5	3.4
1.3	18.05	20.7	82.0	85.4	3.4
1.4	18.47	21.2	88.1	91.4	3.4

BUOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	436.8	67.4	75.1	7.6
0.2	3.98	349.0	69.6	75.2	5.6
0.3	4.41	284.9	71.0	75.2	4.2
0.4	4.83	236.2	71.8	75.0	3.2
0.5	5.26	200.0	72.7	75.2	2.6
0.6	5.68	170.9	73.0	75.1	2.0
0.7	6.11	148.5	73.7	75.4	1.7
0.8	6.53	130.2	74.2	75.6	1.4
0.9	6.96	113.9	73.9	75.1	1.1
1.0	7.39	102.2	74.9	75.9	1.0
1.1	7.81	90.6	74.4	75.3	0.8
1.2	8.24	81.4	74.4	75.1	0.7
1.3	8.66	74.9	75.9	76.5	0.6
1.4	9.09	67.6	75.4	76.0	0.5

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	125.0	66.8	75.9	9.2
0.2	7.11	109.6	67.7	75.4	7.6
0.3	7.53	98.4	69.4	76.0	6.5
0.4	7.96	87.9	70.1	75.7	5.6
0.5	8.39	80.5	72.1	77.0	4.9
0.6	8.81	72.3	72.1	76.4	4.3
0.7	9.24	65.6	72.4	76.1	3.7
0.8	9.66	60.7	73.8	77.1	3.3
0.9	10.09	55.2	73.5	76.4	2.9
1.0	10.51	51.8	75.3	78.0	2.6
1.1	10.94	48.1	76.0	78.4	2.4
1.2	11.37	44.1	75.4	77.5	2.1
1.3	11.79	39.7	73.2	75.1	1.8
1.4	12.22	37.9	75.4	77.0	1.6

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	58.1	66.3	76.1	9.8
0.2	10.24	54.4	68.7	77.6	8.9
0.3	10.66	50.4	69.9	77.9	8.0
0.4	11.09	46.0	69.8	76.9	7.1
0.5	11.51	44.3	73.5	79.9	6.4
0.6	11.94	39.3	70.7	76.2	5.5
0.7	12.37	37.2	72.1	77.4	5.2
0.8	12.79	34.9	73.1	77.7	4.6
0.9	13.22	32.4	72.8	77.1	4.3
1.0	13.64	29.8	71.8	75.5	3.7
1.1	14.07	30.6	78.8	82.5	3.7
1.2	14.49	27.7	75.8	79.2	3.4
1.3	14.92	28.5	82.8	86.2	3.4
1.4	15.35	25.3	78.3	81.0	2.8

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	33.3	65.5	75.8	10.2
0.2	13.37	34.2	72.8	83.0	10.2
0.3	13.79	31.3	72.2	80.9	8.7
0.4	14.22	28.2	69.5	77.5	8.1
0.5	14.64	28.9	76.3	84.4	8.1
0.6	15.07	25.6	72.5	79.0	6.5
0.7	15.49	26.2	79.1	85.6	6.5
0.8	15.92	22.6	72.1	78.0	5.9
0.9	16.35	23.2	78.3	84.2	5.9
1.0	16.77	23.7	84.9	90.8	5.9
1.1	17.20	19.8	75.1	79.5	4.4
1.2	17.62	20.2	81.1	85.4	4.4
1.3	18.05	20.7	87.3	91.7	4.4
1.4	18.47	16.4	72.3	76.0	3.7

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	507.0	72.7	75.1	2.5
0.2	3.98	404.3	73.3	75.1	1.8
0.3	4.41	329.8	73.7	75.1	1.4
0.4	4.83	274.7	74.2	75.2	1.0
0.5	5.26	231.9	74.4	75.2	0.8
0.6	5.68	199.2	74.8	75.5	0.7
0.7	6.11	172.6	75.0	75.5	0.5
0.8	6.53	150.9	75.1	75.6	0.4
0.9	6.96	132.4	74.9	75.2	0.4
1.0	7.39	118.2	75.3	75.6	0.3
1.1	7.81	105.5	75.3	75.5	0.3
1.2	8.24	95.0	75.4	75.6	0.2
1.3	8.66	87.1	76.5	76.7	0.2
1.4	9.09	78.2	75.6	75.8	0.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	143.6	72.3	75.2	2.9
0.2	7.11	127.1	72.9	75.4	2.5
0.3	7.53	114.7	74.2	76.3	2.1
0.4	7.96	102.7	74.5	76.3	1.8
0.5	8.39	91.6	74.0	75.5	1.6
0.6	8.81	83.8	75.0	76.3	1.4
0.7	9.24	75.2	74.0	75.2	1.2
0.8	9.66	70.6	76.2	77.3	1.1
0.9	10.09	62.9	74.2	75.1	0.9
1.0	10.51	59.8	76.7	77.6	0.8
1.1	10.94	53.6	74.6	75.3	0.7
1.2	11.37	49.8	74.7	75.4	0.7
1.3	11.79	48.5	78.4	79.0	0.6
1.4	12.22	44.0	76.4	77.0	0.5

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	69.1	74.8	78.0	3.2
0.2	10.24	62.9	74.6	77.4	2.8
0.3	10.66	59.2	76.3	78.9	2.6
0.4	11.09	55.0	77.0	79.3	2.3
0.5	11.51	50.5	76.5	78.5	2.0
0.6	11.94	45.7	74.6	76.4	1.8
0.7	12.37	43.7	76.7	78.4	1.7
0.8	12.79	41.6	78.4	79.9	1.5
0.9	13.22	39.4	79.2	80.6	1.5
1.0	13.64	36.9	79.3	80.5	1.3
1.1	14.07	34.3	78.3	79.5	1.2
1.2	14.49	31.4	76.5	77.5	1.0
1.3	14.92	32.3	83.2	84.2	1.0
1.4	15.35	29.2	79.7	80.6	0.9

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	40.5	76.1	79.6	3.4
0.2	13.37	37.9	76.4	79.4	3.0
0.3	13.79	35.1	75.4	78.3	2.8
0.4	14.22	32.1	73.6	76.1	2.4
0.5	14.64	32.9	80.3	82.8	2.4
0.6	15.07	29.7	76.7	79.0	2.2
0.7	15.49	30.4	83.3	85.6	2.2
0.8	15.92	26.9	78.0	79.9	1.8
0.9	16.35	27.5	84.4	86.2	1.8
1.0	16.77	23.7	76.6	78.3	1.6
1.1	17.20	24.3	82.6	84.2	1.6
1.2	17.62	24.8	88.8	90.4	1.6
1.3	18.05	20.7	77.8	79.0	1.2
1.4	18.47	21.2	83.5	84.7	1.2

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	469.0	70.9	75.0	4.1
0.2	3.98	374.6	72.2	75.2	3.0
0.3	4.41	305.7	72.9	75.2	2.3
0.4	4.83	254.8	73.6	75.3	1.7
0.5	5.26	214.6	73.8	75.1	1.4
0.6	5.68	183.7	74.0	75.1	1.1
0.7	6.11	159.0	74.3	75.2	0.9
0.8	6.53	139.8	74.8	75.6	0.7
0.9	6.96	122.3	74.4	75.1	0.6
1.0	7.39	109.3	75.0	75.5	0.5
1.1	7.81	98.1	75.4	75.8	0.4
1.2	8.24	89.2	76.2	76.6	0.4
1.3	8.66	79.0	74.8	75.1	0.3
1.4	9.09	71.8	74.9	75.2	0.3

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	134.3	71.1	76.0	4.9
0.2	7.11	117.4	71.1	75.1	4.1
0.3	7.53	104.5	71.6	75.1	3.5
0.4	7.96	94.2	72.6	75.6	3.0
0.5	8.39	85.0	73.1	75.7	2.6
0.6	8.81	76.9	73.4	75.6	2.3
0.7	9.24	70.4	74.1	76.1	2.0
0.8	9.66	65.6	75.8	77.6	1.8
0.9	10.09	60.3	76.2	77.8	1.6
1.0	10.51	54.5	75.0	76.3	1.4
1.1	10.94	50.9	75.9	77.2	1.2
1.2	11.37	46.9	75.7	76.8	1.1
1.3	11.79	42.6	74.1	75.0	1.0
1.4	12.22	40.9	76.5	77.4	0.9

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	63.6	72.2	77.6	5.4
0.2	10.24	57.3	71.4	76.0	4.6
0.3	10.66	53.3	72.6	76.8	4.1
0.4	11.09	49.0	72.6	76.3	3.7
0.5	11.51	47.4	76.1	79.6	3.5
0.6	11.94	42.5	73.6	76.7	3.1
0.7	12.37	40.5	75.6	78.4	2.8
0.8	12.79	38.3	76.7	79.3	2.6
0.9	13.22	35.9	77.1	79.4	2.3
1.0	13.64	33.4	76.5	78.6	2.2
1.1	14.07	30.6	74.9	76.8	1.8
1.2	14.49	31.4	81.8	83.7	1.8
1.3	14.92	28.5	78.5	80.2	1.7
1.4	15.35	25.3	74.1	75.4	1.4

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	36.9	72.8	78.2	5.4
0.2	13.37	34.2	72.2	77.3	5.1
0.3	13.79	31.3	71.0	75.3	4.4
0.4	14.22	32.1	77.8	82.2	4.4
0.5	14.64	28.9	74.5	78.5	4.0
0.6	15.07	29.7	81.3	85.3	4.0
0.7	15.49	26.2	76.5	79.7	3.3
0.8	15.92	26.9	83.0	86.2	3.3
0.9	16.35	23.2	75.5	78.4	2.9
1.0	16.77	23.7	81.6	84.5	2.9
1.1	17.20	24.3	88.0	90.9	2.9
1.2	17.62	20.2	77.4	79.5	2.2
1.3	18.05	20.7	83.2	85.4	2.2
1.4	18.47	21.2	89.3	91.4	2.2

BUOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	3.55	436.8	69.6	75.1	5.5
0.2	3.98	349.0	71.2	75.2	4.0
0.3	4.41	284.9	72.2	75.2	3.0
0.4	4.83	236.2	72.7	75.0	2.3
0.5	5.26	200.0	73.4	75.2	1.8
0.6	5.68	170.9	73.6	75.1	1.5
0.7	6.11	148.5	74.2	75.4	1.2
0.8	6.53	130.2	74.6	75.6	1.0
0.9	6.96	113.9	74.2	75.1	0.8
1.0	7.39	102.2	75.2	75.9	0.7
1.1	7.81	90.6	74.7	75.3	0.6
1.2	8.24	81.4	74.6	75.1	0.5
1.3	8.66	74.9	76.1	76.5	0.4
1.4	9.09	67.6	75.6	76.0	0.4

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	6.68	125.0	69.3	75.9	6.6
0.2	7.11	109.6	69.8	75.4	5.5
0.3	7.53	98.4	71.3	76.0	4.7
0.4	7.96	87.9	71.7	75.7	4.1
0.5	8.39	80.5	73.5	77.0	3.5
0.6	8.81	72.3	73.3	76.4	3.1
0.7	9.24	65.6	73.5	76.1	2.7
0.8	9.66	60.7	74.7	77.1	2.4
0.9	10.09	55.2	74.3	76.4	2.1
1.0	10.51	51.8	76.1	78.0	1.9
1.1	10.94	48.1	76.7	78.4	1.7
1.2	11.37	44.1	76.0	77.5	1.5
1.3	11.79	39.7	73.8	75.1	1.3
1.4	12.22	37.9	75.9	77.0	1.2

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	MODULE WEIGHT SOLID	NET GAIN
0.1	9.81	58.1	69.0	76.1	7.1
0.2	10.24	54.4	71.2	77.6	6.4
0.3	10.66	50.4	72.2	77.9	5.8
0.4	11.09	46.0	71.8	76.9	5.1
0.5	11.51	44.3	75.3	79.9	4.6
0.6	11.94	39.3	72.2	76.2	4.0
0.7	12.37	37.2	73.6	77.4	3.8
0.8	12.79	34.9	74.4	77.7	3.3
0.9	13.22	32.4	74.0	77.1	3.1
1.0	13.64	29.8	72.8	75.5	2.7
1.1	14.07	30.6	79.8	82.5	2.7
1.2	14.49	27.7	76.8	79.2	2.5
1.3	14.92	28.5	83.7	86.2	2.5
1.4	15.35	25.3	79.0	81.0	2.0

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT		NET GAIN
			I	SOLID	
0.1	12.94	33.3	68.4	75.8	7.4
0.2	13.37	34.2	75.7	83.0	7.4
0.3	13.79	31.3	74.6	80.9	6.3
0.4	14.22	28.2	71.7	77.5	5.8
0.5	14.64	28.9	78.5	84.4	5.8
0.6	15.07	25.6	74.3	79.0	4.7
0.7	15.49	26.2	80.9	85.6	4.7
0.8	15.92	22.6	73.7	78.0	4.2
0.9	16.35	23.2	80.0	84.2	4.2
1.0	16.77	23.7	86.5	90.8	4.2
1.1	17.20	19.8	76.3	79.5	3.1
1.2	17.62	20.2	82.3	85.4	3.1
1.3	18.05	20.7	88.5	91.7	3.1
1.4	18.47	16.4	73.3	76.0	2.7

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT		NET GAIN
			I	SOLID	
0.1	3.55	507.0	75.1	75.1	0.0
0.2	3.98	404.3	75.1	75.1	0.0
0.3	4.41	329.8	75.1	75.1	0.0
0.4	4.83	274.7	75.2	75.2	0.0
0.5	5.26	231.9	75.2	75.2	0.0
0.6	5.68	199.2	75.5	75.5	0.0
0.7	6.11	172.6	75.5	75.5	0.0
0.8	6.53	150.9	75.6	75.6	0.0
0.9	6.96	132.4	75.2	75.2	0.0
1.0	7.39	118.2	75.6	75.6	0.0
1.1	7.81	105.5	75.5	75.5	0.0
1.2	8.24	95.0	75.6	75.6	0.0
1.3	8.66	87.1	76.7	76.7	0.0
1.4	9.09	78.2	75.8	75.8	0.0

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT		NET GAIN
			I	SOLID	
0.1	6.68	143.6	75.2	75.2	0.0
0.2	7.11	127.1	75.4	75.4	0.0
0.3	7.53	114.7	76.3	76.3	0.0
0.4	7.96	102.7	76.3	76.3	0.0
0.5	8.39	91.6	75.5	75.5	0.0
0.6	8.81	83.8	76.3	76.3	0.0
0.7	9.24	75.2	75.2	75.2	0.0
0.8	9.66	70.6	77.3	77.3	0.0
0.9	10.09	62.9	75.1	75.1	0.0
1.0	10.51	59.8	77.6	77.6	0.0
1.1	10.94	53.6	75.3	75.3	0.0
1.2	11.37	49.8	75.4	75.4	0.0
1.3	11.79	48.5	79.0	79.0	0.0
1.4	12.22	44.0	77.0	77.0	0.0

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	69.1	78.0	78.0	0.0
0.2	10.24	62.9	77.4	77.4	0.0
0.3	10.66	59.2	78.9	78.9	0.0
0.4	11.09	55.0	79.3	79.3	0.0
0.5	11.51	50.5	78.5	78.5	0.0
0.6	11.94	45.7	76.4	76.4	0.0
0.7	12.37	43.7	78.4	78.4	0.0
0.8	12.79	41.6	79.9	79.9	0.0
0.9	13.22	39.4	80.6	80.6	0.0
1.0	13.64	36.9	80.5	80.5	0.0
1.1	14.07	34.3	79.5	79.5	0.0
1.2	14.49	31.4	77.5	77.5	0.0
1.3	14.92	32.3	84.2	84.2	0.0
1.4	15.35	29.2	80.6	80.6	0.0

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	12.94	40.5	79.6	79.6	0.0
0.2	13.37	37.9	79.4	79.4	0.0
0.3	13.79	35.1	78.3	78.3	0.0
0.4	14.22	32.1	76.1	76.1	0.0
0.5	14.64	32.9	82.8	82.8	0.0
0.6	15.07	29.7	79.0	79.0	0.0
0.7	15.49	30.4	85.6	85.6	0.0
0.8	15.92	26.9	79.9	79.9	0.0
0.9	16.35	27.5	86.2	86.2	0.0
1.0	16.77	23.7	78.3	78.3	0.0
1.1	17.20	24.3	84.2	84.2	0.0
1.2	17.62	24.8	90.4	90.4	0.0
1.3	18.05	20.7	79.0	79.0	0.0
1.4	18.47	21.2	84.7	84.7	0.0

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	469.0	73.2	75.0	1.8
0.2	3.98	374.6	73.8	75.2	1.3
0.3	4.41	305.7	74.1	75.2	1.0
0.4	4.83	254.8	74.6	75.3	0.8
0.5	5.26	214.6	74.5	75.1	0.6
0.6	5.68	183.7	74.6	75.1	0.5
0.7	6.11	159.0	74.8	75.2	0.4
0.8	6.53	139.8	75.3	75.6	0.3
0.9	6.96	122.3	74.8	75.1	0.3
1.0	7.39	109.3	75.3	75.5	0.2
1.1	7.81	98.1	75.6	75.8	0.2
1.2	8.24	89.2	76.5	76.6	0.2
1.3	8.66	79.0	74.9	75.1	0.1
1.4	9.09	71.8	75.0	75.2	0.1

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE	HEXAGON	PRISM	MODULE WEIGHT		NET
INTERVAL	DIAMETER	HEIGHT	I	SOLID	GAIN
0.1	6.68	134.3	73.8	76.0	2.2
0.2	7.11	117.4	73.3	75.1	1.8
0.3	7.53	104.5	73.6	75.1	1.6
0.4	7.96	94.2	74.3	75.6	1.3
0.5	8.39	85.0	74.5	75.7	1.1
0.6	8.81	76.9	74.6	75.6	1.0
0.7	9.24	70.4	75.2	76.1	0.9
0.8	9.66	65.6	76.8	77.6	0.8
0.9	10.09	60.3	77.1	77.8	0.7
1.0	10.51	54.5	75.7	76.3	0.6
1.1	10.94	50.9	76.6	77.2	0.5
1.2	11.37	46.9	76.3	76.8	0.5
1.3	11.79	42.6	74.6	75.0	0.4
1.4	12.22	40.9	77.0	77.4	0.4

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE	HEXAGON	PRISM	MODULE WEIGHT		NET
INTERVAL	DIAMETER	HEIGHT	I	SOLID	GAIN
0.1	9.81	63.6	75.2	77.6	2.4
0.2	10.24	57.3	74.0	76.0	2.0
0.3	10.66	53.3	74.9	76.8	1.8
0.4	11.09	49.0	74.7	76.3	1.6
0.5	11.51	47.4	78.1	79.6	1.6
0.6	11.94	42.5	75.3	76.7	1.4
0.7	12.37	40.5	77.1	78.4	1.2
0.8	12.79	38.3	78.1	79.3	1.2
0.9	13.22	35.9	78.4	79.4	1.0
1.0	13.64	33.4	77.7	78.6	1.0
1.1	14.07	30.6	76.0	76.8	0.8
1.2	14.49	31.4	82.9	83.7	0.8
1.3	14.92	28.5	79.5	80.2	0.8
1.4	15.35	25.3	74.8	75.4	0.6

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE	HEXAGON	PRISM	MODULE WEIGHT		NET
INTERVAL	DIAMETER	HEIGHT	I	SOLID	GAIN
0.1	12.94	36.9	75.8	78.2	2.4
0.2	13.37	34.2	75.0	77.3	2.3
0.3	13.79	31.3	73.4	75.3	1.9
0.4	14.22	32.1	80.2	82.2	1.9
0.5	14.64	28.9	76.8	78.5	1.8
0.6	15.07	29.7	83.5	85.3	1.8
0.7	15.49	26.2	78.3	79.7	1.5
0.8	15.92	26.9	84.8	86.2	1.5
0.9	16.35	23.2	77.1	78.4	1.3
1.0	16.77	23.7	83.2	84.5	1.3
1.1	17.20	24.3	89.6	90.9	1.3
1.2	17.62	20.2	78.6	79.5	1.0
1.3	18.05	20.7	84.4	85.4	1.0
1.4	18.47	21.2	90.5	91.4	1.0

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	3.55	436.8	71.7	75.1	3.4
0.2	3.98	349.0	72.7	75.2	2.5
0.3	4.41	284.9	73.4	75.2	1.9
0.4	4.83	236.2	73.6	75.0	1.4
0.5	5.26	200.0	74.1	75.2	1.1
0.6	5.68	170.9	74.2	75.1	0.9
0.7	6.11	148.5	74.6	75.4	0.7
0.8	6.53	130.2	75.0	75.6	0.6
0.9	6.96	113.9	74.6	75.1	0.5
1.0	7.39	102.2	75.4	75.9	0.4
1.1	7.81	90.6	74.9	75.3	0.4
1.2	8.24	81.4	74.8	75.1	0.3
1.3	8.66	74.9	76.2	76.5	0.3
1.4	9.09	67.6	75.7	76.0	0.2

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	6.68	125.0	71.9	75.9	4.1
0.2	7.11	109.6	72.0	75.4	3.4
0.3	7.53	98.4	73.1	76.0	2.9
0.4	7.96	87.9	73.2	75.7	2.5
0.5	8.39	80.5	74.9	77.0	2.2
0.6	8.81	72.3	74.5	76.4	1.9
0.7	9.24	65.6	74.5	76.1	1.7
0.8	9.66	60.7	75.6	77.1	1.5
0.9	10.09	55.2	75.1	76.4	1.3
1.0	10.51	51.8	76.8	78.0	1.2
1.1	10.94	48.1	77.3	78.4	1.1
1.2	11.37	44.1	76.6	77.5	0.9
1.3	11.79	39.7	74.3	75.1	0.8
1.4	12.22	37.9	76.3	77.0	0.7

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT I	SOLID	NET GAIN
0.1	9.81	58.1	71.8	76.1	4.4
0.2	10.24	54.4	73.6	77.6	4.0
0.3	10.66	50.4	74.4	77.9	3.6
0.4	11.09	46.0	73.8	76.9	3.1
0.5	11.51	44.3	77.1	79.9	2.9
0.6	11.94	39.3	73.7	76.2	2.5
0.7	12.37	37.2	75.0	77.4	2.3
0.8	12.79	34.9	75.6	77.7	2.0
0.9	13.22	32.4	75.2	77.1	1.9
1.0	13.64	29.8	73.8	75.5	1.6
1.1	14.07	30.6	80.8	82.5	1.6
1.2	14.49	27.7	77.7	79.2	1.5
1.3	14.92	28.5	84.7	86.2	1.5
1.4	15.35	25.3	79.8	81.0	1.2

BJOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT i	MODULE WEIGHT SOLID	NET GAIN
0.1	12.94	33.3	71.2	75.8	4.5
0.2	13.37	34.2	78.5	83.0	4.5
0.3	13.79	31.3	77.0	80.9	3.9
0.4	14.22	28.2	73.9	77.5	3.6
0.5	14.64	28.9	80.8	84.4	3.6
0.6	15.07	25.6	76.1	79.0	2.9
0.7	15.49	26.2	82.7	85.6	2.9
0.8	15.92	22.6	75.4	78.0	2.6
0.9	16.35	23.2	81.6	84.2	2.6
1.0	16.77	23.7	88.2	90.8	2.6
1.1	17.20	19.8	77.6	79.5	1.9
1.2	17.62	20.2	83.5	85.4	1.9
1.3	18.05	20.7	89.7	91.7	1.9
1.4	18.47	16.4	74.4	76.0	1.6

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	179.6	46.2	75.3	29.1
0.2	6.38	146.0	53.6	75.3	21.7
0.3	7.01	121.4	58.8	75.5	16.7
0.4	7.63	102.3	62.5	75.4	13.0
0.5	8.26	87.1	64.9	75.2	10.3
0.6	8.88	75.9	67.4	75.9	8.4
0.7	9.51	65.7	68.4	75.2	6.8
0.8	10.13	58.4	70.3	76.0	5.7
0.9	10.76	51.6	70.9	75.7	4.7
1.0	11.39	47.3	73.6	77.7	4.1
1.1	12.01	42.3	73.8	77.2	3.5
1.2	12.64	38.5	74.8	77.8	3.0
1.3	13.26	34.2	73.6	76.1	2.5
1.4	13.89	31.4	74.6	76.8	2.2

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	50.6	41.4	75.9	34.5
0.2	11.51	45.3	46.6	76.0	29.4
0.3	12.13	41.3	51.7	77.1	25.3
0.4	12.76	36.8	54.1	75.9	21.8
0.5	13.39	34.0	57.9	77.2	19.3
0.6	14.01	30.8	60.0	76.7	16.7
0.7	14.64	29.7	65.4	80.6	15.2
0.8	15.26	25.9	63.8	76.5	12.7
0.9	15.89	24.4	66.2	77.9	11.7
1.0	16.51	22.6	68.0	78.1	10.1
1.1	17.14	20.7	67.8	77.0	9.1
1.2	17.77	21.4	76.4	85.6	9.1
1.3	18.39	19.2	74.7	82.3	7.6
1.4	19.02	16.8	70.6	77.2	6.6

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	42.3	81.7	39.4
0.2	16.64	23.2	47.3	81.5	34.2
0.3	17.26	21.1	48.9	79.8	30.9
0.4	17.89	18.9	50.8	76.5	25.6
0.5	18.51	19.5	59.0	84.7	25.6
0.6	19.14	17.0	56.4	78.7	22.3
0.7	19.77	17.5	64.3	86.7	22.3
0.8	20.39	14.7	60.3	77.4	17.1
0.9	21.02	15.2	67.8	84.9	17.1
1.0	21.64	15.6	75.7	92.7	17.1
1.1	22.27	12.5	64.5	78.3	13.8
1.2	22.89	12.8	71.5	85.3	13.8
1.3	23.52	13.2	78.8	92.6	13.8
1.4	24.15	13.6	86.6	100.4	13.8

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	44.9	85.5	40.5
0.2	21.77	15.6	52.9	93.4	40.5
0.3	22.39	12.2	44.9	77.6	32.7
0.4	23.02	12.6	51.9	84.5	32.7
0.5	23.64	13.0	59.2	91.9	32.7
0.6	24.27	13.4	66.9	99.6	32.7
0.7	24.89	9.6	54.8	75.1	20.3
0.8	25.52	9.9	61.0	81.3	20.3
0.9	26.15	10.1	67.6	87.8	20.3
1.0	26.77	10.4	74.4	94.7	20.3
1.1	27.40	10.7	81.6	101.9	20.3
1.2	28.02	11.0	89.2	109.5	20.3
1.3	28.65	11.3	97.2	117.4	20.3
1.4	29.27	11.6	105.5	125.7	20.3

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	193.2	69.2	75.0	5.8
0.2	6.38	157.7	70.9	75.3	4.3
0.3	7.01	130.6	71.9	75.2	3.3
0.4	7.63	111.0	73.2	75.8	2.6
0.5	8.26	95.0	73.9	76.0	2.1
0.6	8.88	81.6	73.8	75.5	1.7
0.7	9.51	71.7	74.6	76.0	1.4
0.8	10.13	63.2	75.0	76.1	1.1
0.9	10.76	56.7	76.0	76.9	1.0
1.0	11.39	50.8	76.5	77.3	0.8
1.1	12.01	46.0	77.1	77.8	0.7
1.2	12.64	40.4	75.1	75.7	0.6
1.3	13.26	38.2	78.4	78.9	0.5
1.4	13.89	33.6	75.5	75.9	0.4

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	54.3	68.6	75.4	6.9
0.2	11.51	49.2	70.5	76.4	5.9
0.3	12.13	45.4	73.2	78.4	5.2
0.4	12.76	41.1	73.9	78.4	4.5
0.5	13.39	36.2	72.4	76.1	3.8
0.6	14.01	33.1	73.0	76.3	3.3
0.7	14.64	32.1	77.6	80.7	3.1
0.8	15.26	28.4	75.0	77.6	2.6
0.9	15.89	26.9	77.4	79.7	2.3
1.0	16.51	25.3	78.6	80.8	2.2
1.1	17.14	23.4	78.8	80.7	1.9
1.2	17.77	21.4	77.6	79.3	1.7
1.3	18.39	19.2	74.8	76.2	1.4
1.4	19.02	19.9	82.8	84.2	1.4

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	68.4	75.7	7.3
0.2	16.64	23.2	69.1	75.5	6.3
0.3	17.26	24.1	77.8	84.1	6.3
0.4	17.89	21.9	76.4	82.1	5.7
0.5	18.51	19.5	73.7	78.4	4.7
0.6	19.14	20.1	81.8	86.6	4.7
0.7	19.77	17.5	76.1	80.2	4.1
0.8	20.39	18.1	84.0	88.1	4.1
0.9	21.02	15.2	75.4	78.6	3.2
1.0	21.64	15.6	82.7	85.9	3.2
1.1	22.27	16.1	90.5	93.6	3.2
1.2	22.89	12.8	76.4	78.9	2.6
1.3	23.52	13.2	83.2	85.8	2.6
1.4	24.15	13.6	90.4	93.0	2.6

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	71.6	79.1	7.5
0.2	21.77	15.6	79.0	86.5	7.5
0.3	22.39	16.0	86.8	94.3	7.5
0.4	23.02	12.6	72.2	78.3	6.1
0.5	23.64	13.0	79.0	85.1	6.1
0.6	24.27	13.4	86.2	92.2	6.1
0.7	24.89	13.7	93.7	99.8	6.1
0.8	25.52	9.9	71.5	75.3	3.8
0.9	26.15	10.1	77.6	81.3	3.8
1.0	26.77	10.4	83.9	87.7	3.8
1.1	27.40	10.7	90.6	94.4	3.8
1.2	28.02	11.0	97.6	101.4	3.8
1.3	28.65	11.3	105.0	108.7	3.8
1.4	29.27	11.6	112.7	116.4	3.8

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	179.6	67.8	75.3	7.5
0.2	6.38	146.0	69.6	75.3	5.6
0.3	7.01	121.4	71.1	75.5	4.3
0.4	7.63	102.3	72.1	75.4	3.4
0.5	8.26	87.1	72.5	75.2	2.7
0.6	8.88	75.9	73.7	75.9	2.2
0.7	9.51	65.7	73.4	75.2	1.8
0.8	10.13	58.4	74.5	76.0	1.5
0.9	10.76	51.6	74.5	75.7	1.2
1.0	11.39	47.3	76.6	77.7	1.1
1.1	12.01	42.3	76.3	77.2	0.9
1.2	12.64	38.5	77.1	77.8	0.8
1.3	13.26	34.2	75.5	76.1	0.7
1.4	13.89	31.4	76.2	76.8	0.6

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	50.6	66.9	75.9	8.9
0.2	11.51	45.3	68.3	76.0	7.6
0.3	12.13	41.3	70.5	77.1	6.6
0.4	12.76	36.8	70.3	75.9	5.7
0.5	13.39	34.0	72.2	77.2	5.0
0.6	14.01	30.8	72.4	76.7	4.3
0.7	14.64	29.7	76.7	80.6	3.9
0.8	15.26	25.9	73.2	76.5	3.3
0.9	15.89	24.4	74.8	77.9	3.0
1.0	16.51	22.6	75.5	78.1	2.6
1.1	17.14	20.7	74.6	77.0	2.4
1.2	17.77	21.4	83.2	85.6	2.4
1.3	18.39	19.2	80.4	82.3	2.0
1.4	19.02	16.8	75.5	77.2	1.7

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	71.5	81.7	10.2
0.2	16.64	23.2	72.6	81.5	8.9
0.3	17.26	21.1	71.8	79.8	8.0
0.4	17.89	18.9	69.8	76.5	6.6
0.5	18.51	19.5	78.0	84.7	6.6
0.6	19.14	17.0	72.9	78.7	5.8
0.7	19.77	17.5	80.9	86.7	5.8
0.8	20.39	14.7	73.0	77.4	4.4
0.9	21.02	15.2	80.4	84.9	4.4
1.0	21.64	15.6	88.3	92.7	4.4
1.1	22.27	12.5	74.7	78.3	3.6
1.2	22.89	12.8	81.7	85.3	3.6
1.3	23.52	13.2	89.1	92.6	3.6
1.4	24.15	13.6	96.8	100.4	3.6

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	75.0	85.5	10.5
0.2	21.77	15.6	82.9	93.4	10.5
0.3	22.39	12.2	69.1	77.6	8.5
0.4	23.02	12.6	76.1	84.5	8.5
0.5	23.64	13.0	83.4	91.9	8.5
0.6	24.27	13.4	91.1	99.6	8.5
0.7	24.89	9.6	69.8	75.1	5.3
0.8	25.52	9.9	76.0	81.3	5.3
0.9	26.15	10.1	82.6	87.8	5.3
1.0	26.77	10.4	89.4	94.7	5.3
1.1	27.40	10.7	96.7	101.9	5.3
1.2	28.02	11.0	104.2	109.5	5.3
1.3	28.65	11.3	112.2	117.4	5.3
1.4	29.27	11.6	120.5	125.7	5.3

BJOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	166.9	66.1	75.2	9.0
0.2	6.38	136.4	68.8	75.5	6.8
0.3	7.01	113.3	70.5	75.7	5.2
0.4	7.63	94.8	71.1	75.1	4.0
0.5	8.26	81.7	72.6	75.8	3.2
0.6	8.88	70.2	72.8	75.4	2.6
0.7	9.51	61.1	73.1	75.2	2.1
0.8	10.13	55.2	75.4	77.2	1.8
0.9	10.76	48.3	74.5	76.0	1.5
1.0	11.39	43.8	75.9	77.2	1.3
1.1	12.01	38.6	74.6	75.7	1.1
1.2	12.64	34.6	74.2	75.1	0.9
1.3	13.26	32.1	76.1	76.9	0.8
1.4	13.89	29.3	76.2	76.9	0.7

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	46.9	64.8	75.5	10.6
0.2	11.51	43.3	68.8	78.1	9.3
0.3	12.13	39.3	70.6	78.7	8.1
0.4	12.76	34.7	70.1	76.9	6.8
0.5	13.39	31.8	71.6	77.5	5.9
0.6	14.01	28.5	71.2	76.2	5.1
0.7	14.64	27.3	74.9	79.6	4.7
0.8	15.26	25.9	77.9	82.2	4.2
0.9	15.89	24.4	79.8	83.6	3.9
1.0	16.51	22.6	80.5	83.9	3.4
1.1	17.14	20.7	79.6	82.7	3.0
1.2	17.77	18.6	77.2	79.8	2.5
1.3	18.39	19.2	85.9	88.4	2.5
1.4	19.02	16.8	80.7	82.9	2.2

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	22.4	66.8	78.2	11.4
0.2	16.64	20.4	66.6	76.9	10.3
0.3	17.26	21.1	75.4	85.7	10.3
0.4	17.89	18.9	73.6	82.1	8.5
0.5	18.51	16.4	69.1	76.5	7.4
0.6	19.14	17.0	77.1	84.5	7.4
0.7	19.77	14.2	70.0	75.7	5.7
0.8	20.39	14.7	77.5	83.2	5.7
0.9	21.02	15.2	85.4	91.1	5.7
1.0	21.64	12.1	72.4	77.0	4.6
1.1	22.27	12.5	79.5	84.1	4.6
1.2	22.89	12.8	87.0	91.6	4.6
1.3	23.52	13.2	94.9	99.5	4.6
1.4	24.15	9.7	74.1	76.9	2.8

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	78.3	91.8	13.5
0.2	21.77	11.8	65.4	76.3	10.9
0.3	22.39	12.2	72.5	83.3	10.9
0.4	23.02	12.6	79.9	90.8	10.9
0.5	23.64	13.0	87.8	98.7	10.9
0.6	24.27	13.4	96.1	107.0	10.9
0.7	24.89	9.6	73.9	80.6	6.8
0.8	25.52	9.9	80.5	87.3	6.8
0.9	26.15	10.1	87.6	94.3	6.8
1.0	26.77	10.4	94.9	101.7	6.8
1.1	27.40	10.7	102.7	109.5	6.8
1.2	28.02	11.0	110.8	117.6	6.8
1.3	28.65	11.3	119.4	126.1	6.8
1.4	29.27	11.6	128.3	135.1	6.8

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	193.2	72.1	75.0	2.9
0.2	6.38	157.7	73.1	75.3	2.2
0.3	7.01	130.6	73.5	75.2	1.7
0.4	7.63	111.0	74.5	75.8	1.3
0.5	8.26	95.0	74.9	76.0	1.0
0.6	8.88	81.6	74.7	75.5	0.8
0.7	9.51	71.7	75.3	76.0	0.7
0.8	10.13	63.2	75.6	76.1	0.6
0.9	10.76	56.7	76.5	76.9	0.5
1.0	11.39	50.8	76.9	77.3	0.4
1.1	12.01	46.0	77.5	77.8	0.4
1.2	12.64	40.4	75.4	75.7	0.3
1.3	13.26	38.2	78.6	78.9	0.3
1.4	13.89	33.6	75.7	75.9	0.2

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	54.3	72.0	75.4	3.4
0.2	11.51	49.2	73.4	76.4	3.0
0.3	12.13	45.4	75.8	78.4	2.6
0.4	12.76	41.1	76.2	78.4	2.3
0.5	13.39	36.2	74.2	76.1	1.9
0.6	14.01	33.1	74.7	76.3	1.6
0.7	14.64	32.1	79.1	80.7	1.6
0.8	15.26	28.4	76.3	77.6	1.3
0.9	15.89	26.9	78.5	79.7	1.2
1.0	16.51	25.3	79.7	80.8	1.1
1.1	17.14	23.4	79.8	80.7	0.9
1.2	17.77	21.4	78.4	79.3	0.8
1.3	18.39	19.2	75.5	76.2	0.7
1.4	19.02	19.9	83.5	84.2	0.7

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	72.0	75.7	3.7
0.2	16.64	23.2	72.3	75.5	3.2
0.3	17.26	24.1	80.9	84.1	3.2
0.4	17.89	21.9	79.2	82.1	2.9
0.5	18.51	19.5	76.0	78.4	2.4
0.6	19.14	20.1	84.2	86.6	2.4
0.7	19.77	17.5	78.2	80.2	2.1
0.8	20.39	18.1	86.0	88.1	2.1
0.9	21.02	15.2	77.0	78.6	1.6
1.0	21.64	15.6	84.3	85.9	1.6
1.1	22.27	16.1	92.0	93.6	1.6
1.2	22.89	12.8	77.7	78.9	1.3
1.3	23.52	13.2	84.5	85.8	1.3
1.4	24.15	13.6	91.7	93.0	1.3

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	75.4	79.1	3.8
0.2	21.77	15.6	82.7	86.5	3.8
0.3	22.39	16.0	90.5	94.3	3.8
0.4	23.02	12.6	75.2	78.3	3.0
0.5	23.64	13.0	82.0	85.1	3.0
0.6	24.27	13.4	89.2	92.2	3.0
0.7	24.89	13.7	96.8	99.8	3.0
0.8	25.52	9.9	73.4	75.3	1.9
0.9	26.15	10.1	79.4	81.3	1.9
1.0	26.77	10.4	85.8	87.7	1.9
1.1	27.40	10.7	92.5	94.4	1.9
1.2	28.02	11.0	99.5	101.4	1.9
1.3	28.65	11.3	106.9	108.7	1.9
1.4	29.27	11.6	114.6	116.4	1.9

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	179.6	70.5	75.3	4.9
0.2	6.38	146.0	71.7	75.3	3.6
0.3	7.01	121.4	72.7	75.5	2.8
0.4	7.63	102.3	73.3	75.4	2.2
0.5	8.26	87.1	73.5	75.2	1.7
0.6	8.88	75.9	74.5	75.9	1.4
0.7	9.51	65.7	74.1	75.2	1.1
0.8	10.13	58.4	75.0	76.0	0.9
0.9	10.76	51.6	74.9	75.7	0.8
1.0	11.39	47.3	77.0	77.7	0.7
1.1	12.01	42.3	76.7	77.2	0.6
1.2	12.64	38.5	77.3	77.8	0.5
1.3	13.26	34.2	75.7	76.1	0.4
1.4	13.89	31.4	76.5	76.8	0.4

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	50.6	70.1	75.9	5.7
0.2	11.51	45.3	71.1	76.0	4.9
0.3	12.13	41.3	72.8	77.1	4.2
0.4	12.76	36.8	72.3	75.9	3.6
0.5	13.39	34.0	74.0	77.2	3.2
0.6	14.01	30.8	73.9	76.7	2.8
0.7	14.64	29.7	78.1	80.6	2.5
0.8	15.26	25.9	74.4	76.5	2.1
0.9	15.89	24.4	75.9	77.9	1.9
1.0	16.51	22.6	76.4	78.1	1.7
1.1	17.14	20.7	75.4	77.0	1.5
1.2	17.77	21.4	84.1	85.6	1.5
1.3	18.39	19.2	81.1	82.3	1.3
1.4	19.02	16.8	76.1	77.2	1.1

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	75.2	81.7	6.6
0.2	16.64	23.2	75.8	81.5	5.7
0.3	17.26	21.1	74.7	79.8	5.1
0.4	17.89	18.9	72.2	76.5	4.3
0.5	18.51	19.5	80.4	84.7	4.3
0.6	19.14	17.0	75.0	78.7	3.7
0.7	19.77	17.5	82.9	86.7	3.7
0.8	20.39	14.7	74.6	77.4	2.8
0.9	21.02	15.2	82.0	84.9	2.8
1.0	21.64	15.6	89.9	92.7	2.8
1.1	22.27	12.5	76.0	78.3	2.3
1.2	22.89	12.8	83.0	85.3	2.3
1.3	23.52	13.2	90.3	92.6	2.3
1.4	24.15	13.6	98.1	100.4	2.3

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	78.7	85.5	6.8
0.2	21.77	15.6	86.6	93.4	6.8
0.3	22.39	12.2	72.2	77.6	5.4
0.4	23.02	12.6	79.1	84.5	5.4
0.5	23.64	13.0	86.4	91.9	5.4
0.6	24.27	13.4	94.2	99.6	5.4
0.7	24.89	9.6	71.7	75.1	3.4
0.8	25.52	9.9	77.9	81.3	3.4
0.9	26.15	10.1	84.4	87.8	3.4
1.0	26.77	10.4	91.3	94.7	3.4
1.1	27.40	10.7	98.5	101.9	3.4
1.2	28.02	11.0	106.1	109.5	3.4
1.3	28.65	11.3	114.1	117.4	3.4
1.4	29.27	11.6	122.4	125.7	3.4

BJOYANCY MODULE DATA

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	166.9	68.7	75.2	6.5
0.2	6.38	136.4	70.7	75.5	4.9
0.3	7.01	113.3	71.9	75.7	3.7
0.4	7.63	94.8	72.2	75.1	2.9
0.5	8.26	81.7	73.5	75.8	2.3
0.6	8.88	70.2	73.5	75.4	1.9
0.7	9.51	61.1	73.7	75.2	1.5
0.8	10.13	55.2	75.9	77.2	1.3
0.9	10.76	48.3	74.9	76.0	1.1
1.0	11.39	43.8	76.3	77.2	0.9
1.1	12.01	38.6	74.9	75.7	0.8
1.2	12.64	34.6	74.5	75.1	0.7
1.3	13.26	32.1	76.3	76.9	0.6
1.4	13.89	29.3	76.4	76.9	0.5

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	46.9	67.8	75.5	7.7
0.2	11.51	43.3	71.4	78.1	6.7
0.3	12.13	39.3	72.8	78.7	5.9
0.4	12.76	34.7	72.0	76.9	4.9
0.5	13.39	31.8	73.2	77.5	4.3
0.6	14.01	28.5	72.6	76.2	3.7
0.7	14.64	27.3	76.2	79.6	3.4
0.8	15.26	25.9	79.1	82.2	3.0
0.9	15.89	24.4	80.8	83.6	2.8
1.0	16.51	22.6	81.4	83.9	2.4
1.1	17.14	20.7	80.4	82.7	2.2
1.2	17.77	18.6	77.9	79.8	1.8
1.3	18.39	19.2	86.6	88.4	1.8
1.4	19.02	16.8	81.3	82.9	1.6

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	22.4	70.0	78.2	8.2
0.2	16.64	20.4	69.4	76.9	7.4
0.3	17.26	21.1	78.3	85.7	7.4
0.4	17.89	18.9	75.9	82.1	6.2
0.5	18.51	16.4	71.1	76.5	5.4
0.6	19.14	17.0	79.1	84.5	5.4
0.7	19.77	14.2	71.5	75.7	4.1
0.8	20.39	14.7	79.0	83.2	4.1
0.9	21.02	15.2	87.0	91.1	4.1
1.0	21.64	12.1	73.7	77.0	3.3
1.1	22.27	12.5	80.8	84.1	3.3
1.2	22.89	12.8	88.3	91.6	3.3
1.3	23.52	13.2	96.2	99.5	3.3
1.4	24.15	9.7	74.9	76.9	2.1

BUOYANCY MODULE DATA

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	MODULE WEIGHT SOLID	NET GAIN
0.1	21.14	15.1	82.0	91.8	9.8
0.2	21.77	11.8	68.5	76.3	7.9
0.3	22.39	12.2	75.5	83.3	7.9
0.4	23.02	12.6	82.9	90.8	7.9
0.5	23.64	13.0	90.8	98.7	7.9
0.6	24.27	13.4	99.1	107.0	7.9
0.7	24.89	9.6	75.8	80.6	4.9
0.8	25.52	9.9	82.4	87.3	4.9
0.9	26.15	10.1	89.4	94.3	4.9
1.0	26.77	10.4	96.8	101.7	4.9
1.1	27.40	10.7	104.6	109.5	4.9
1.2	28.02	11.0	112.7	117.6	4.9
1.3	28.65	11.3	121.2	126.1	4.9
1.4	29.27	11.6	130.2	135.1	4.9

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	MODULE WEIGHT SOLID	NET GAIN
0.1	5.75	193.2	75.0	75.0	0.0
0.2	6.38	157.7	75.3	75.3	0.0
0.3	7.01	130.6	75.2	75.2	0.0
0.4	7.63	111.0	75.8	75.8	0.0
0.5	8.26	95.0	76.0	76.0	0.0
0.6	8.88	81.6	75.5	75.5	0.0
0.7	9.51	71.7	76.0	76.0	0.0
0.8	10.13	63.2	76.1	76.1	0.0
0.9	10.76	56.7	76.9	76.9	0.0
1.0	11.39	50.8	77.3	77.3	0.0
1.1	12.01	46.0	77.8	77.8	0.0
1.2	12.64	40.4	75.7	75.7	0.0
1.3	13.26	38.2	78.9	78.9	0.0
1.4	13.89	33.6	75.9	75.9	0.0

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	MODULE WEIGHT SOLID	NET GAIN
0.1	10.88	54.3	75.4	75.4	0.0
0.2	11.51	49.2	76.4	76.4	0.0
0.3	12.13	45.4	78.4	78.4	0.0
0.4	12.76	41.1	78.4	78.4	0.0
0.5	13.39	36.2	76.1	76.1	0.0
0.6	14.01	33.1	76.3	76.3	0.0
0.7	14.64	32.1	80.7	80.7	0.0
0.8	15.26	28.4	77.6	77.6	0.0
0.9	15.89	26.9	79.7	79.7	0.0
1.0	16.51	25.3	80.8	80.8	0.0
1.1	17.14	23.4	80.7	80.7	0.0
1.2	17.77	21.4	79.3	79.3	0.0
1.3	18.39	19.2	76.2	76.2	0.0
1.4	19.02	19.9	84.2	84.2	0.0

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	75.7	75.7	0.0
0.2	16.64	23.2	75.5	75.5	0.0
0.3	17.26	24.1	84.1	84.1	0.0
0.4	17.89	21.9	82.1	82.1	0.0
0.5	18.51	19.5	78.4	78.4	0.0
0.6	19.14	20.1	86.6	86.6	0.0
0.7	19.77	17.5	80.2	80.2	0.0
0.8	20.39	18.1	88.1	88.1	0.0
0.9	21.02	15.2	78.6	78.6	0.0
1.0	21.64	15.6	85.9	85.9	0.0
1.1	22.27	16.1	93.6	93.6	0.0
1.2	22.89	12.8	78.9	78.9	0.0
1.3	23.52	13.2	85.8	85.8	0.0
1.4	24.15	13.6	93.0	93.0	0.0

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	79.1	79.1	0.0
0.2	21.77	15.6	86.5	86.5	0.0
0.3	22.39	16.0	94.3	94.3	0.0
0.4	23.02	12.6	78.3	78.3	0.0
0.5	23.64	13.0	85.1	85.1	0.0
0.6	24.27	13.4	92.2	92.2	0.0
0.7	24.89	13.7	99.8	99.8	0.0
0.8	25.52	9.9	75.3	75.3	0.0
0.9	26.15	10.1	81.3	81.3	0.0
1.0	26.77	10.4	87.7	87.7	0.0
1.1	27.40	10.7	94.4	94.4	0.0
1.2	28.02	11.0	101.4	101.4	0.0
1.3	28.65	11.3	108.7	108.7	0.0
1.4	29.27	11.6	116.4	116.4	0.0

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	179.6	73.1	75.3	2.2
0.2	6.38	146.0	73.7	75.3	1.6
0.3	7.01	121.4	74.2	75.5	1.2
0.4	7.63	102.3	74.5	75.4	1.0
0.5	8.26	87.1	74.4	75.2	0.8
0.6	8.88	75.9	75.2	75.9	0.6
0.7	9.51	65.7	74.7	75.2	0.5
0.8	10.13	58.4	75.6	76.0	0.4
0.9	10.76	51.6	75.3	75.7	0.4
1.0	11.39	47.3	77.4	77.7	0.3
1.1	12.01	42.3	77.0	77.2	0.3
1.2	12.64	38.5	77.6	77.8	0.2
1.3	13.26	34.2	75.9	76.1	0.2
1.4	13.89	31.4	76.7	76.8	0.2

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	50.6	73.3	75.9	2.6
0.2	11.51	45.3	73.8	76.0	2.2
0.3	12.13	41.3	75.2	77.1	1.9
0.4	12.76	36.8	74.3	75.9	1.6
0.5	13.39	34.0	75.8	77.2	1.4
0.6	14.01	30.8	75.5	76.7	1.2
0.7	14.64	29.7	79.5	80.6	1.1
0.8	15.26	25.9	75.6	76.5	0.9
0.9	15.89	24.4	77.0	77.9	0.9
1.0	16.51	22.6	77.3	78.1	0.8
1.1	17.14	20.7	76.3	77.0	0.7
1.2	17.77	21.4	84.9	85.6	0.7
1.3	18.39	19.2	81.8	82.3	0.6
1.4	19.02	16.8	76.7	77.2	0.5

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	25.2	78.8	81.7	2.9
0.2	16.64	23.2	79.0	81.5	2.5
0.3	17.26	21.1	77.5	79.8	2.3
0.4	17.89	18.9	74.6	76.5	1.9
0.5	18.51	19.5	82.8	84.7	1.9
0.6	19.14	17.0	77.0	78.7	1.7
0.7	19.77	17.5	85.0	86.7	1.7
0.8	20.39	14.7	76.2	77.4	1.3
0.9	21.02	15.2	83.6	84.9	1.3
1.0	21.64	15.6	91.5	92.7	1.3
1.1	22.27	12.5	77.3	78.3	1.0
1.2	22.89	12.8	84.2	85.3	1.0
1.3	23.52	13.2	91.6	92.6	1.0
1.4	24.15	13.6	99.4	100.4	1.0

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	82.5	85.5	3.0
0.2	21.77	15.6	90.4	93.4	3.0
0.3	22.39	12.2	75.2	77.6	2.4
0.4	23.02	12.6	82.1	84.5	2.4
0.5	23.64	13.0	89.4	91.9	2.4
0.6	24.27	13.4	97.2	99.6	2.4
0.7	24.89	9.6	73.6	75.1	1.5
0.8	25.52	9.9	79.8	81.3	1.5
0.9	26.15	10.1	86.3	87.8	1.5
1.0	26.77	10.4	93.2	94.7	1.5
1.1	27.40	10.7	100.4	101.9	1.5
1.2	28.02	11.0	108.0	109.5	1.5
1.3	28.65	11.3	115.9	117.4	1.5
1.4	29.27	11.6	124.2	125.7	1.5

BJOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	5.75	166.9	71.2	75.2	4.0
0.2	6.38	136.4	72.5	75.5	3.0
0.3	7.01	113.3	73.4	75.7	2.3
0.4	7.63	94.8	73.4	75.1	1.8
0.5	8.26	81.7	74.4	75.8	1.4
0.6	8.88	70.2	74.3	75.4	1.2
0.7	9.51	61.1	74.3	75.2	0.9
0.8	10.13	55.2	76.4	77.2	0.8
0.9	10.76	48.3	75.3	76.0	0.7
1.0	11.39	43.8	76.6	77.2	0.6
1.1	12.01	38.6	75.2	75.7	0.5
1.2	12.64	34.6	74.7	75.1	0.4
1.3	13.26	32.1	76.5	76.9	0.4
1.4	13.89	29.3	76.6	76.9	0.3

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	10.88	46.9	70.8	75.5	4.7
0.2	11.51	43.3	74.0	78.1	4.1
0.3	12.13	39.3	75.1	78.7	3.6
0.4	12.76	34.7	73.9	76.9	3.0
0.5	13.39	31.8	74.9	77.5	2.6
0.6	14.01	28.5	74.0	76.2	2.3
0.7	14.64	27.3	77.5	79.6	2.1
0.8	15.26	25.9	80.3	82.2	1.9
0.9	15.89	24.4	81.9	83.6	1.7
1.0	16.51	22.6	82.4	83.9	1.5
1.1	17.14	20.7	81.3	82.7	1.4
1.2	17.77	18.6	78.6	79.8	1.1
1.3	18.39	19.2	87.3	88.4	1.1
1.4	19.02	16.8	81.9	82.9	1.0

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	16.01	22.4	73.2	78.2	5.1
0.2	16.64	20.4	72.3	76.9	4.6
0.3	17.26	21.1	81.1	85.7	4.6
0.4	17.89	18.9	78.3	82.1	3.8
0.5	18.51	16.4	73.2	76.5	3.3
0.6	19.14	17.0	81.2	84.5	3.3
0.7	19.77	14.2	73.1	75.7	2.5
0.8	20.39	14.7	80.6	83.2	2.5
0.9	21.02	15.2	88.6	91.1	2.5
1.0	21.64	12.1	75.0	77.0	2.0
1.1	22.27	12.5	82.1	84.1	2.0
1.2	22.89	12.8	89.5	91.6	2.0
1.3	23.52	13.2	97.4	99.5	2.0
1.4	24.15	9.7	75.7	76.9	1.3

BUOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT II	SOLID	NET GAIN
0.1	21.14	15.1	85.8	91.8	6.0
0.2	21.77	11.8	71.5	76.3	4.8
0.3	22.39	12.2	78.5	83.3	4.8
0.4	23.02	12.6	86.0	90.8	4.8
0.5	23.64	13.0	93.8	98.7	4.8
0.6	24.27	13.4	102.1	107.0	4.8
0.7	24.89	9.6	77.6	80.6	3.0
0.8	25.52	9.9	84.3	87.3	3.0
0.9	26.15	10.1	91.3	94.3	3.0
1.0	26.77	10.4	98.7	101.7	3.0
1.1	27.40	10.7	106.5	109.5	3.0
1.2	28.02	11.0	114.6	117.6	3.0
1.3	28.65	11.3	123.1	126.1	3.0
1.4	29.27	11.6	132.1	135.1	3.0

BUOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	469.0	50.5	75.0	24.5
0.2	3.98	374.6	57.2	75.2	18.0
0.3	4.41	305.7	61.6	75.2	13.5
0.4	4.83	254.8	64.9	75.3	10.4
0.5	5.26	214.6	66.9	75.1	8.2
0.6	5.68	183.7	68.6	75.1	6.6
0.7	6.11	159.0	69.8	75.2	5.3
0.8	6.53	139.8	71.2	75.6	4.4
0.9	6.96	122.3	71.4	75.1	3.7
1.0	7.39	109.3	72.4	75.5	3.1
1.1	7.81	98.1	73.2	75.8	2.7
1.2	8.24	89.2	74.4	76.6	2.3
1.3	8.66	79.0	73.2	75.1	1.9
1.4	9.09	71.8	73.5	75.2	1.7

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	134.3	46.6	76.0	29.4
0.2	7.11	117.4	50.6	75.1	24.5
0.3	7.53	104.5	54.5	75.1	20.7
0.4	7.96	94.2	57.7	75.6	18.0
0.5	8.39	85.0	60.2	75.7	15.5
0.6	8.81	76.9	62.3	75.6	13.3
0.7	9.24	70.4	64.4	76.1	11.7
0.8	9.66	65.6	67.0	77.6	10.6
0.9	10.09	60.3	68.5	77.8	9.2
1.0	10.51	54.5	68.2	76.3	8.2
1.1	10.94	50.9	69.8	77.2	7.4
1.2	11.37	46.9	70.3	76.8	6.5
1.3	11.79	42.6	69.3	75.0	5.7
1.4	12.22	40.9	72.3	77.4	5.1

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	63.6	46.4	77.6	31.2
0.2	10.24	57.3	48.5	76.0	27.6
0.3	10.66	53.3	52.0	76.8	24.8
0.4	11.09	49.0	54.2	76.3	22.1
0.5	11.51	47.4	59.5	79.6	20.1
0.6	11.94	42.5	59.3	76.7	17.4
0.7	12.37	40.5	61.8	78.4	16.5
0.8	12.79	38.3	64.7	79.3	14.6
0.9	13.22	35.9	65.7	79.4	13.8
1.0	13.64	33.4	66.8	78.6	11.9
1.1	14.07	30.6	65.8	76.8	11.0
1.2	14.49	31.4	72.7	83.7	11.0
1.3	14.92	28.5	71.1	80.2	9.1
1.4	15.35	25.3	67.2	75.4	8.3

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	12.94	36.9	45.6	78.2	32.7
0.2	13.37	34.2	49.2	77.3	28.1
0.3	13.79	31.3	49.2	75.3	26.1
0.4	14.22	32.1	56.0	82.2	26.1
0.5	14.64	28.9	57.0	78.5	21.6
0.6	15.07	29.7	63.7	85.3	21.6
0.7	15.49	26.2	60.1	79.7	19.6
0.8	15.92	26.9	66.6	86.2	19.6
0.9	16.35	23.2	63.4	78.4	15.0
1.0	16.77	23.7	69.5	84.5	15.0
1.1	17.20	24.3	75.9	90.9	15.0
1.2	17.62	20.2	66.5	79.5	13.1
1.3	18.05	20.7	72.3	85.4	13.1
1.4	18.47	21.2	78.4	91.4	13.1

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	3.55	507.0	70.2	75.1	4.9
0.2	3.98	404.3	71.5	75.1	3.6
0.3	4.41	329.8	72.4	75.1	2.7
0.4	4.83	274.7	73.1	75.2	2.1
0.5	5.26	231.9	73.5	75.2	1.6
0.6	5.68	199.2	74.1	75.5	1.3
0.7	6.11	172.6	74.5	75.5	1.1
0.8	6.53	150.9	74.7	75.6	0.9
0.9	6.96	132.4	74.5	75.2	0.7
1.0	7.39	118.2	75.0	75.6	0.6
1.1	7.81	105.5	75.0	75.5	0.5
1.2	8.24	95.0	75.2	75.6	0.5
1.3	8.66	87.1	76.3	76.7	0.4
1.4	9.09	78.2	75.4	75.8	0.3

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	6.68	143.6	69.4	75.2	5.8
0.2	7.11	127.1	70.5	75.4	4.9
0.3	7.53	114.7	72.1	76.3	4.2
0.4	7.96	102.7	72.7	76.3	3.6
0.5	8.39	91.6	72.5	75.5	3.1
0.6	8.81	83.8	73.6	76.3	2.7
0.7	9.24	75.2	72.9	75.2	2.3
0.8	9.66	70.6	75.2	77.3	2.1
0.9	10.09	62.9	73.3	75.1	1.8
1.0	10.51	59.8	75.9	77.6	1.7
1.1	10.94	53.6	73.9	75.3	1.4
1.2	11.37	49.8	74.1	75.4	1.3
1.3	11.79	48.5	77.8	79.0	1.2
1.4	12.22	44.0	75.9	77.0	1.1

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	69.1	71.8	78.0	6.3
0.2	10.24	62.9	71.7	77.4	5.6
0.3	10.66	59.2	73.8	78.9	5.1
0.4	11.09	55.0	74.7	79.3	4.6
0.5	11.51	50.5	74.5	78.5	4.1
0.6	11.94	45.7	72.8	76.4	3.6
0.7	12.37	43.7	75.2	78.4	3.2
0.8	12.79	41.6	76.8	79.9	3.1
0.9	13.22	39.4	77.9	80.6	2.7
1.0	13.64	36.9	78.0	80.5	2.6
1.1	14.07	34.3	77.3	79.5	2.2
1.2	14.49	31.4	75.4	77.5	2.0
1.3	14.92	32.3	82.2	84.2	2.0
1.4	15.35	29.2	78.9	80.6	1.7

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	40.5	73.2	79.6	6.4
0.2	13.37	37.9	73.3	79.4	6.1
0.3	13.79	35.1	73.0	78.3	5.2
0.4	14.22	32.1	71.2	76.1	4.8
0.5	14.64	32.9	77.9	82.8	4.8
0.6	15.07	29.7	75.0	79.0	4.0
0.7	15.49	30.4	81.6	85.6	4.0
0.8	15.92	26.9	76.2	79.9	3.6
0.9	16.35	27.5	82.6	86.2	3.6
1.0	16.77	23.7	75.5	78.3	2.8
1.1	17.20	24.3	81.4	84.2	2.8
1.2	17.62	24.8	87.7	90.4	2.8
1.3	18.05	20.7	76.6	79.0	2.4
1.4	18.47	21.2	82.3	84.7	2.4

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	469.0	68.7	75.0	6.4
0.2	3.98	374.6	70.5	75.2	4.7
0.3	4.41	305.7	71.6	75.2	3.5
0.4	4.83	254.8	72.6	75.3	2.7
0.5	5.26	214.6	73.0	75.1	2.1
0.6	5.68	183.7	73.4	75.1	1.7
0.7	6.11	159.0	73.8	75.2	1.4
0.8	6.53	139.8	74.4	75.6	1.1
0.9	6.96	122.3	74.1	75.1	1.0
1.0	7.39	109.3	74.7	75.5	0.8
1.1	7.81	98.1	75.1	75.8	0.7
1.2	8.24	89.2	76.0	76.6	0.6
1.3	8.66	79.0	74.6	75.1	0.5
1.4	9.09	71.8	74.7	75.2	0.4

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	134.3	68.3	76.0	7.6
0.2	7.11	117.4	68.8	75.1	6.4
0.3	7.53	104.5	69.8	75.1	5.4
0.4	7.96	94.2	71.0	75.6	4.7
0.5	8.39	85.0	71.6	75.7	4.0
0.6	8.81	76.9	72.2	75.6	3.5
0.7	9.24	70.4	73.0	76.1	3.0
0.8	9.66	65.6	74.9	77.6	2.8
0.9	10.09	60.3	75.4	77.8	2.4
1.0	10.51	54.5	74.2	76.3	2.1
1.1	10.94	50.9	75.2	77.2	1.9
1.2	11.37	46.9	75.1	76.8	1.7
1.3	11.79	42.6	73.6	75.0	1.5
1.4	12.22	40.9	76.1	77.4	1.3

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	63.6	69.5	77.6	8.1
0.2	10.24	57.3	68.9	76.0	7.1
0.3	10.66	53.3	70.3	76.8	6.4
0.4	11.09	49.0	70.6	76.3	5.7
0.5	11.51	47.4	74.4	79.6	5.2
0.6	11.94	42.5	72.2	76.7	4.5
0.7	12.37	40.5	74.1	78.4	4.3
0.8	12.79	38.3	75.5	79.3	3.8
0.9	13.22	35.9	75.9	79.4	3.6
1.0	13.64	33.4	75.6	78.6	3.1
1.1	14.07	30.6	73.9	76.8	2.9
1.2	14.49	31.4	80.8	83.7	2.9
1.3	14.92	28.5	77.9	80.2	2.4
1.4	15.35	25.3	73.3	75.4	2.1

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	36.9	69.8	78.2	8.5
0.2	13.37	34.2	70.0	77.3	7.3
0.3	13.79	31.3	68.6	75.3	6.8
0.4	14.22	32.1	75.4	82.2	6.8
0.5	14.64	28.9	73.0	78.5	5.6
0.6	15.07	29.7	79.7	85.3	5.6
0.7	15.49	26.2	74.7	79.7	5.1
0.8	15.92	26.9	81.2	86.2	5.1
0.9	16.35	23.2	74.5	78.4	3.9
1.0	16.77	23.7	80.6	84.5	3.9
1.1	17.20	24.3	87.0	90.9	3.9
1.2	17.62	20.2	76.2	79.5	3.4
1.3	18.05	20.7	82.0	85.4	3.4
1.4	18.47	21.2	88.1	91.4	3.4

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	436.8	67.4	75.1	7.6
0.2	3.98	349.0	69.6	75.2	5.6
0.3	4.41	284.9	71.0	75.2	4.2
0.4	4.83	236.2	71.8	75.0	3.2
0.5	5.26	200.0	72.7	75.2	2.6
0.6	5.68	170.9	73.0	75.1	2.0
0.7	6.11	148.5	73.7	75.4	1.7
0.8	6.53	130.2	74.2	75.6	1.4
0.9	6.96	113.9	73.9	75.1	1.1
1.0	7.39	102.2	74.9	75.9	1.0
1.1	7.81	90.6	74.4	75.3	0.8
1.2	8.24	81.4	74.4	75.1	0.7
1.3	8.66	74.9	75.9	76.5	0.6
1.4	9.09	67.6	75.4	76.0	0.5

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	125.0	66.9	75.9	9.1
0.2	7.11	109.6	67.7	75.4	7.6
0.3	7.53	98.4	69.4	76.0	6.5
0.4	7.96	87.9	70.2	75.7	5.5
0.5	8.39	80.5	72.1	77.0	4.9
0.6	8.81	72.3	72.2	76.4	4.2
0.7	9.24	65.6	72.5	76.1	3.6
0.8	9.66	60.7	73.8	77.1	3.3
0.9	10.09	55.2	73.6	76.4	2.8
1.0	10.51	51.8	75.4	78.0	2.5
1.1	10.94	48.1	76.1	78.4	2.3
1.2	11.37	44.1	75.5	77.5	2.0
1.3	11.79	39.7	73.4	75.1	1.7
1.4	12.22	37.9	75.4	77.0	1.6

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	58.1	66.7	76.1	9.5
0.2	10.24	54.4	69.1	77.6	8.5
0.3	10.66	50.4	70.3	77.9	7.6
0.4	11.09	46.0	70.2	76.9	6.7
0.5	11.51	44.3	73.5	79.9	6.4
0.6	11.94	39.3	70.7	76.2	5.5
0.7	12.37	37.2	72.5	77.4	4.9
0.8	12.79	34.9	73.1	77.7	4.6
0.9	13.22	32.4	73.2	77.1	4.0
1.0	13.64	29.8	71.8	75.5	3.7
1.1	14.07	30.6	78.8	82.5	3.7
1.2	14.49	27.7	76.2	79.2	3.0
1.3	14.92	28.5	83.2	86.2	3.0
1.4	15.35	25.3	78.3	81.0	2.8

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	33.3	66.4	75.8	9.4
0.2	13.37	34.2	73.7	83.0	9.4
0.3	13.79	31.3	72.2	80.9	8.7
0.4	14.22	28.2	70.3	77.5	7.2
0.5	14.64	28.9	77.2	84.4	7.2
0.6	15.07	25.6	72.5	79.0	6.5
0.7	15.49	26.2	79.1	85.6	6.5
0.8	15.92	22.6	73.0	78.0	5.0
0.9	16.35	23.2	79.2	84.2	5.0
1.0	16.77	23.7	85.8	90.8	5.0
1.1	17.20	19.8	75.1	79.5	4.4
1.2	17.62	20.2	81.1	85.4	4.4
1.3	18.05	20.7	87.3	91.7	4.4
1.4	18.47	16.4	73.2	76.0	2.8

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	507.0	72.7	75.1	2.5
0.2	3.98	404.3	73.3	75.1	1.8
0.3	4.41	329.8	73.7	75.1	1.4
0.4	4.83	274.7	74.2	75.2	1.0
0.5	5.26	231.9	74.4	75.2	0.8
0.6	5.68	199.2	74.8	75.5	0.7
0.7	6.11	172.6	75.0	75.5	0.5
0.8	6.53	150.9	75.1	75.6	0.4
0.9	6.96	132.4	74.9	75.2	0.4
1.0	7.39	118.2	75.3	75.6	0.3
1.1	7.81	105.5	75.3	75.5	0.3
1.2	8.24	95.0	75.4	75.6	0.2
1.3	8.66	87.1	76.5	76.7	0.2
1.4	9.09	78.2	75.6	75.8	0.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	143.6	72.3	75.2	2.9
0.2	7.11	127.1	72.9	75.4	2.4
0.3	7.53	114.7	74.2	76.3	2.1
0.4	7.96	102.7	74.5	76.3	1.8
0.5	8.39	91.6	74.0	75.5	1.5
0.6	8.81	83.8	75.0	76.3	1.4
0.7	9.24	75.2	74.1	75.2	1.2
0.8	9.66	70.6	76.2	77.3	1.1
0.9	10.09	62.9	74.2	75.1	0.9
1.0	10.51	59.8	76.7	77.6	0.8
1.1	10.94	53.6	74.6	75.3	0.7
1.2	11.37	49.8	74.8	75.4	0.6
1.3	11.79	48.5	78.4	79.0	0.6
1.4	12.22	44.0	76.4	77.0	0.5

*****
INCLUDED SPHERE DIAMETER = 3.0J INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	69.1	74.9	78.0	3.1
0.2	10.24	62.9	74.6	77.4	2.8
0.3	1J.66	59.2	76.3	78.9	2.6
0.4	11.09	55.0	77.0	79.3	2.3
0.5	11.51	50.5	76.5	78.5	2.0
0.6	11.94	45.7	74.6	76.4	1.8
0.7	12.37	43.7	76.8	78.4	1.6
0.8	12.79	41.6	78.4	79.9	1.5
0.9	13.22	39.4	79.3	80.6	1.4
1.0	13.64	36.9	79.3	80.5	1.3
1.1	14.07	34.3	78.4	79.5	1.1
1.2	14.49	31.4	76.5	77.5	1.0
1.3	14.92	32.3	83.2	84.2	1.0
1.4	15.35	29.2	79.8	80.6	0.8

*****
INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	40.5	76.4	79.6	3.2
0.2	13.37	37.9	76.4	79.4	3.0
0.3	13.79	35.1	75.6	78.3	2.6
0.4	14.22	32.1	73.6	76.1	2.4
0.5	14.64	32.9	80.3	82.8	2.4
0.6	15.07	29.7	77.0	79.0	2.0
0.7	15.49	30.4	83.6	85.6	2.0
0.8	15.92	26.9	78.0	79.9	1.8
J.9	16.35	27.5	84.4	86.2	1.8
1.0	16.77	23.7	76.9	78.3	1.4
1.1	17.20	24.3	82.8	84.2	1.4
1.2	17.62	24.8	89.0	90.4	1.4
1.3	18.05	20.7	77.8	79.0	1.2
1.4	18.47	21.2	83.5	84.7	1.2

*****
INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.45J SYNTACTIC FOAM S.G.= J.54J
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	469.0	71.0	75.0	4.1
0.2	3.98	374.6	72.2	75.2	3.0
0.3	4.41	305.7	72.9	75.2	2.3
J.4	4.83	254.8	73.6	75.3	1.7
0.5	5.26	214.6	73.8	75.1	1.4
0.6	5.68	183.7	74.0	75.1	1.1
0.7	6.11	159.0	74.3	75.2	0.9
0.8	6.53	139.8	74.8	75.6	0.7
0.9	6.96	122.3	74.4	75.1	J.6
1.0	7.39	109.3	75.0	75.5	0.5
1.1	7.81	98.1	75.4	75.8	0.4
1.2	8.24	89.2	76.3	76.6	0.4
1.3	8.66	79.0	74.8	75.1	0.3
1.4	9.09	71.8	74.9	75.2	0.3

BUOYANCY MODULE DATA

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	134.3	71.1	76.0	4.9
0.2	7.11	117.4	71.1	75.1	4.1
0.3	7.53	104.5	71.7	75.1	3.4
0.4	7.96	94.2	72.6	75.6	3.0
0.5	8.39	85.0	73.1	75.7	2.6
0.6	8.81	76.9	73.4	75.6	2.2
0.7	9.24	70.4	74.1	76.1	1.9
0.8	9.66	65.6	75.8	77.6	1.8
0.9	10.09	60.3	76.2	77.8	1.5
1.0	10.51	54.5	75.0	76.3	1.4
1.1	10.94	50.9	75.9	77.2	1.2
1.2	11.37	46.9	75.7	76.8	1.1
1.3	11.79	42.6	74.1	75.0	1.0
1.4	12.22	40.9	76.6	77.4	0.9

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	63.6	72.4	77.6	5.2
0.2	10.24	57.3	71.4	76.0	4.6
0.3	10.66	53.3	72.6	76.8	4.1
0.4	11.09	49.0	72.6	76.3	3.7
0.5	11.51	47.4	76.3	79.6	3.4
0.6	11.94	42.5	73.8	76.7	2.9
0.7	12.37	40.5	75.6	78.4	2.8
0.8	12.79	38.3	76.9	79.3	2.4
0.9	13.22	35.9	77.1	79.4	2.3
1.0	13.64	33.4	76.7	78.6	2.0
1.1	14.07	30.6	74.9	76.8	1.8
1.2	14.49	31.4	81.8	83.7	1.8
1.3	14.92	28.5	78.7	80.2	1.5
1.4	15.35	25.3	74.1	75.4	1.4

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	36.9	72.8	78.2	5.4
0.2	13.37	34.2	72.6	77.3	4.7
0.3	13.79	31.3	71.0	75.3	4.4
0.4	14.22	32.1	77.8	82.2	4.4
0.5	14.64	28.9	75.0	78.5	3.6
0.6	15.07	29.7	81.7	85.3	3.6
0.7	15.49	26.2	76.5	79.7	3.3
0.8	15.92	26.9	83.0	86.2	3.3
0.9	16.35	23.2	75.9	78.4	2.5
1.0	16.77	23.7	82.0	84.5	2.5
1.1	17.20	24.3	88.4	90.9	2.5
1.2	17.62	20.2	77.4	79.5	2.2
1.3	18.05	20.7	83.2	85.4	2.2
1.4	18.47	21.2	89.3	91.4	2.2

*****
INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	436.8	69.6	75.1	5.5
0.2	3.98	349.0	71.2	75.2	4.0
0.3	4.41	284.9	72.2	75.2	3.0
0.4	4.83	236.2	72.7	75.0	2.3
0.5	5.26	200.0	73.4	75.2	1.8
0.6	5.68	170.9	73.6	75.1	1.5
0.7	6.11	148.5	74.2	75.4	1.2
0.8	6.53	130.2	74.6	75.6	1.0
0.9	6.96	113.9	74.2	75.1	0.8
1.0	7.39	102.2	75.2	75.9	0.7
1.1	7.81	90.6	74.7	75.3	0.6
1.2	8.24	81.4	74.6	75.1	0.5
1.3	8.66	74.9	76.1	76.5	0.4
1.4	9.09	67.6	75.6	76.0	0.4

*****
INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	125.0	69.4	75.9	6.5
0.2	7.11	109.6	69.8	75.4	5.5
0.3	7.53	98.4	71.3	76.0	4.7
0.4	7.96	87.9	71.7	75.7	4.0
0.5	8.39	80.5	73.5	77.0	3.5
0.6	8.81	72.3	73.4	76.4	3.0
0.7	9.24	65.6	73.5	76.1	2.6
0.8	9.66	60.7	74.7	77.1	2.4
0.9	10.09	55.2	74.4	76.4	2.0
1.0	10.51	51.8	76.1	78.0	1.8
1.1	10.94	48.1	76.8	78.4	1.6
1.2	11.37	44.1	76.1	77.5	1.4
1.3	11.79	39.7	73.8	75.1	1.2
1.4	12.22	37.9	75.9	77.0	1.2

*****
INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	58.1	69.3	76.1	6.8
0.2	10.24	54.4	71.4	77.6	6.2
0.3	10.66	50.4	72.4	77.9	5.5
0.4	11.09	46.0	72.1	76.9	4.8
0.5	11.51	44.3	75.3	79.9	4.6
0.6	11.94	39.3	72.2	76.2	4.0
0.7	12.37	37.2	73.8	77.4	3.5
0.8	12.79	34.9	74.4	77.7	3.3
0.9	13.22	32.4	74.3	77.1	2.9
1.0	13.64	29.8	72.8	75.5	2.7
1.1	14.07	30.6	79.8	82.5	2.7
1.2	14.49	27.7	77.1	79.2	2.2
1.3	14.92	28.5	84.0	86.2	2.2
1.4	15.35	25.3	79.0	81.0	2.0

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	33.3	69.0	75.8	6.8
0.2	13.37	34.2	76.3	83.0	6.8
0.3	13.79	31.3	74.6	80.9	6.3
0.4	14.22	28.2	72.3	77.5	5.2
0.5	14.64	28.9	79.2	84.4	5.2
0.6	15.07	25.6	74.3	79.0	4.7
0.7	15.49	26.2	80.9	85.6	4.7
0.8	15.92	22.6	74.3	78.0	3.6
0.9	16.35	23.2	80.6	84.2	3.6
1.0	16.77	23.7	87.2	90.8	3.6
1.1	17.20	19.8	76.3	79.5	3.1
1.2	17.62	20.2	82.3	85.4	3.1
1.3	18.05	20.7	88.5	91.7	3.1
1.4	18.47	16.4	74.0	76.0	2.0

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	507.0	75.1	75.1	0.0
0.2	3.98	404.3	75.1	75.1	0.0
0.3	4.41	329.8	75.1	75.1	0.0
0.4	4.83	274.7	75.2	75.2	0.0
0.5	5.26	231.9	75.2	75.2	0.0
0.6	5.68	199.2	75.5	75.5	0.0
0.7	6.11	172.6	75.5	75.5	0.0
0.8	6.53	150.9	75.6	75.6	0.0
0.9	6.96	132.4	75.2	75.2	0.0
1.0	7.39	118.2	75.6	75.6	0.0
1.1	7.81	105.5	75.5	75.5	0.0
1.2	8.24	95.0	75.6	75.6	0.0
1.3	8.66	87.1	76.7	76.7	0.0
1.4	9.09	78.2	75.8	75.8	0.0

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	143.6	75.2	75.2	0.0
0.2	7.11	127.1	75.4	75.4	0.0
0.3	7.53	114.7	76.3	76.3	0.0
0.4	7.96	102.7	76.3	76.3	0.0
0.5	8.39	91.6	75.5	75.5	0.0
0.6	8.81	83.8	76.3	76.3	0.0
0.7	9.24	75.2	75.2	75.2	0.0
0.8	9.66	70.6	77.3	77.3	0.0
0.9	10.09	62.9	75.1	75.1	0.0
1.0	10.51	59.8	77.6	77.6	0.0
1.1	10.94	53.6	75.3	75.3	0.0
1.2	11.37	49.8	75.4	75.4	0.0
1.3	11.79	48.5	79.0	79.0	0.0
1.4	12.22	44.0	77.0	77.0	0.0

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	69.1	78.0	78.0	0.0
0.2	10.24	62.9	77.4	77.4	0.0
0.3	10.66	59.2	78.9	78.9	0.0
0.4	11.09	55.0	79.3	79.3	0.0
0.5	11.51	50.5	78.5	78.5	0.0
0.6	11.94	45.7	76.4	76.4	0.0
0.7	12.37	43.7	78.4	78.4	0.0
0.8	12.79	41.6	79.9	79.9	0.0
0.9	13.22	39.4	80.6	80.6	0.0
1.0	13.64	36.9	80.5	80.5	0.0
1.1	14.07	34.3	79.5	79.5	0.0
1.2	14.49	31.4	77.5	77.5	0.0
1.3	14.92	32.3	84.2	84.2	0.0
1.4	15.35	29.2	80.6	80.6	0.0

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	40.5	79.6	79.6	0.0
0.2	13.37	37.9	79.4	79.4	0.0
0.3	13.79	35.1	78.3	78.3	0.0
0.4	14.22	32.1	76.1	76.1	0.0
0.5	14.64	32.9	82.8	82.8	0.0
0.6	15.07	29.7	79.0	79.0	0.0
0.7	15.49	30.4	85.6	85.6	0.0
0.8	15.92	26.9	79.9	79.9	0.0
0.9	16.35	27.5	86.2	86.2	0.0
1.0	16.77	23.7	78.3	78.3	0.0
1.1	17.20	24.3	84.2	84.2	0.0
1.2	17.62	24.8	90.4	90.4	0.0
1.3	18.05	20.7	79.0	79.0	0.0
1.4	18.47	21.2	84.7	84.7	0.0

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	469.0	73.2	75.0	1.8
0.2	3.98	374.6	73.8	75.2	1.3
0.3	4.41	305.7	74.2	75.2	1.0
0.4	4.83	254.8	74.6	75.3	0.8
0.5	5.26	214.6	74.5	75.1	0.6
0.6	5.68	183.7	74.6	75.1	0.5
0.7	6.11	159.0	74.8	75.2	0.4
0.8	6.53	139.8	75.3	75.6	0.3
0.9	6.96	122.3	74.8	75.1	0.3
1.0	7.39	109.3	75.3	75.5	0.2
1.1	7.81	98.1	75.6	75.8	0.2
1.2	8.24	89.2	76.5	76.6	0.2
1.3	8.66	79.0	74.9	75.1	0.1
1.4	9.09	71.8	75.0	75.2	0.1

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	6.68	134.3	73.8	76.0	2.2
0.2	7.11	117.4	73.3	75.1	1.8
0.3	7.53	104.5	73.6	75.1	1.5
0.4	7.96	94.2	74.3	75.6	1.3
0.5	8.39	85.0	74.5	75.7	1.1
0.6	8.81	76.9	74.7	75.6	1.0
0.7	9.24	70.4	75.2	76.1	0.9
0.8	9.66	65.6	76.8	77.6	0.8
0.9	10.09	60.3	77.1	77.8	0.7
1.0	10.51	54.5	75.7	76.3	0.6
1.1	10.94	50.9	76.6	77.2	0.5
1.2	11.37	46.9	76.3	76.8	0.5
1.3	11.79	42.6	74.6	75.0	0.4
1.4	12.22	40.9	77.0	77.4	0.4

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	9.81	63.6	75.3	77.6	2.3
0.2	10.24	57.3	74.0	76.0	2.0
0.3	10.66	53.3	74.9	76.8	1.8
0.4	11.09	49.0	74.7	76.3	1.6
0.5	11.51	47.4	78.1	79.6	1.5
0.6	11.94	42.5	75.4	76.7	1.3
0.7	12.37	40.5	77.1	78.4	1.2
0.8	12.79	38.3	78.2	79.3	1.1
0.9	13.22	35.9	78.4	79.4	1.0
1.0	13.64	33.4	77.8	78.6	0.9
1.1	14.07	30.6	76.0	76.8	0.8
1.2	14.49	31.4	82.9	83.7	0.8
1.3	14.92	28.5	79.6	80.2	0.7
1.4	15.35	25.3	74.8	75.4	0.6

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	MODULE WEIGHT SOLID	NET GAIN
0.1	12.94	36.9	75.8	78.2	2.4
0.2	13.37	34.2	75.2	77.3	2.1
0.3	13.79	31.3	73.4	75.3	1.9
0.4	14.22	32.1	80.2	82.2	1.9
0.5	14.64	28.9	77.0	78.5	1.6
0.6	15.07	29.7	83.7	85.3	1.6
0.7	15.49	26.2	78.3	79.7	1.5
0.8	15.92	26.9	84.8	86.2	1.5
0.9	16.35	23.2	77.3	78.4	1.1
1.0	16.77	23.7	83.4	84.5	1.1
1.1	17.20	24.3	89.8	90.9	1.1
1.2	17.62	20.2	78.6	79.5	1.0
1.3	18.05	20.7	84.4	85.4	1.0
1.4	18.47	21.2	90.5	91.4	1.0

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	3.55	436.8	71.7	75.1	3.4
0.2	3.98	349.0	72.7	75.2	2.5
0.3	4.41	284.9	73.4	75.2	1.9
0.4	4.83	236.2	73.6	75.0	1.4
0.5	5.26	200.0	74.1	75.2	1.1
0.6	5.68	170.9	74.2	75.1	0.9
0.7	6.11	148.5	74.6	75.4	0.7
0.8	6.53	130.2	75.0	75.6	0.6
0.9	6.96	113.9	74.6	75.1	0.5
1.0	7.39	102.2	75.4	75.9	0.4
1.1	7.81	90.6	74.9	75.3	0.4
1.2	8.24	81.4	74.8	75.1	0.3
1.3	8.66	74.9	76.2	76.5	0.3
1.4	9.09	67.6	75.7	76.0	0.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	6.68	125.0	71.9	75.9	4.0
0.2	7.11	109.6	72.0	75.4	3.4
0.3	7.53	98.4	73.1	76.0	2.9
0.4	7.96	87.9	73.3	75.7	2.5
0.5	8.39	80.5	74.9	77.0	2.2
0.6	8.81	72.3	74.5	76.4	1.9
0.7	9.24	65.6	74.5	76.1	1.6
0.8	9.66	60.7	75.6	77.1	1.5
0.9	10.09	55.2	75.2	76.4	1.2
1.0	10.51	51.8	76.8	78.0	1.1
1.1	10.94	48.1	77.4	78.4	1.0
1.2	11.37	44.1	76.6	77.5	0.9
1.3	11.79	39.7	74.3	75.1	0.8
1.4	12.22	37.9	76.3	77.0	0.7

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	9.81	58.1	71.9	76.1	4.2
0.2	10.24	54.4	73.8	77.6	3.8
0.3	10.66	50.4	74.5	77.9	3.4
0.4	11.09	46.0	73.9	76.9	3.0
0.5	11.51	44.3	77.1	79.9	2.9
0.6	11.94	39.3	73.7	76.2	2.5
0.7	12.37	37.2	75.2	77.4	2.2
0.8	12.79	34.9	75.6	77.7	2.0
0.9	13.22	32.4	75.4	77.1	1.8
1.0	13.64	29.8	73.8	75.5	1.6
1.1	14.07	30.6	80.8	82.5	1.6
1.2	14.49	27.7	77.9	79.2	1.3
1.3	14.92	28.5	84.8	86.2	1.3
1.4	15.35	25.3	79.8	81.0	1.2

*****
INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT III	SOLID	NET GAIN
0.1	12.94	33.3	71.6	75.8	4.2
0.2	13.37	34.2	78.9	83.0	4.2
0.3	13.79	31.3	77.0	80.9	3.9
0.4	14.22	28.2	74.3	77.5	3.2
0.5	14.64	28.9	81.2	84.4	3.2
0.6	15.07	25.6	76.1	79.0	2.9
0.7	15.49	26.2	82.7	85.6	2.9
0.8	15.92	22.6	75.7	78.0	2.2
0.9	16.35	23.2	82.0	84.2	2.2
1.0	16.77	23.7	88.5	90.8	2.2
1.1	17.20	19.8	77.6	79.5	1.9
1.2	17.62	20.2	83.5	85.4	1.9
1.3	18.05	20.7	89.7	91.7	1.9
1.4	18.47	16.4	74.7	76.0	1.3

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	179.6	46.2	75.3	29.1
0.2	6.38	146.0	53.6	75.3	21.6
0.3	7.01	121.4	58.9	75.5	16.6
0.4	7.63	102.3	62.5	75.4	13.0
0.5	8.26	87.1	64.9	75.2	10.3
0.6	8.88	75.9	67.5	75.9	8.4
0.7	9.51	65.7	68.4	75.2	6.8
0.8	10.13	58.4	70.3	76.0	5.7
0.9	10.76	51.6	70.9	75.7	4.7
1.0	11.39	47.3	73.6	77.7	4.1
1.1	12.01	42.3	73.8	77.2	3.5
1.2	12.64	38.5	74.9	77.8	3.0
1.3	13.26	34.2	73.6	76.1	2.5
1.4	13.89	31.4	74.6	76.8	2.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	50.6	42.0	75.9	33.9
0.2	11.51	45.3	47.1	76.0	28.8
0.3	12.13	41.3	51.7	77.1	25.3
0.4	12.76	36.8	54.7	75.9	21.2
0.5	13.39	34.0	58.5	77.2	18.7
0.6	14.01	30.8	60.5	76.7	16.2
0.7	14.64	29.7	65.4	80.6	15.2
0.8	15.26	25.9	63.8	76.5	12.7
0.9	15.89	24.4	66.8	77.9	11.1
1.0	16.51	22.6	68.0	78.1	10.1
1.1	17.14	20.7	68.4	77.0	8.6
1.2	17.77	21.4	77.0	85.6	8.6
1.3	18.39	19.2	74.7	82.3	7.6
1.4	19.02	16.8	71.1	77.2	6.0

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	44.2	81.7	37.5
0.2	16.64	23.2	47.3	81.5	34.2
0.3	17.26	21.1	50.9	79.8	28.9
0.4	17.89	18.9	50.8	76.5	25.6
0.5	18.51	19.5	59.0	84.7	25.6
0.6	19.14	17.0	58.3	78.7	20.4
0.7	19.77	17.5	66.3	86.7	20.4
0.8	20.39	14.7	60.3	77.4	17.1
0.9	21.02	15.2	67.8	84.9	17.1
1.0	21.64	15.6	75.7	92.7	17.1
1.1	22.27	12.5	66.4	78.3	11.9
1.2	22.89	12.8	73.4	85.3	11.9
1.3	23.52	13.2	80.8	92.6	11.9
1.4	24.15	13.6	88.6	100.4	11.9

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.0 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	21.14	15.1	44.9	85.5	40.5
0.2	21.77	15.6	52.9	93.4	40.5
0.3	22.39	12.2	49.5	77.6	28.1
0.4	23.02	12.6	56.4	84.5	28.1
0.5	23.64	13.0	63.8	91.9	28.1
0.6	24.27	13.4	71.5	99.6	28.1
0.7	24.89	9.6	54.8	75.1	20.3
0.8	25.52	9.9	61.0	81.3	20.3
0.9	26.15	10.1	67.6	87.8	20.3
1.0	26.77	10.4	74.4	94.7	20.3
1.1	27.40	10.7	81.6	101.9	20.3
1.2	28.02	11.0	89.2	109.5	20.3
1.3	28.65	11.3	97.2	117.4	20.3
1.4	29.27	11.6	105.5	125.7	20.3

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	5.75	193.2	69.2	75.0	5.8
0.2	6.38	157.7	70.9	75.3	4.3
0.3	7.01	130.6	71.9	75.2	3.3
0.4	7.63	111.0	73.2	75.8	2.6
0.5	8.26	95.0	73.9	76.0	2.1
0.6	8.88	81.6	73.8	75.5	1.7
0.7	9.51	71.7	74.6	76.0	1.4
0.8	10.13	63.2	75.0	76.1	1.1
0.9	10.76	56.7	76.0	76.9	1.0
1.0	11.39	50.8	76.5	77.3	0.8
1.1	12.01	46.0	77.1	77.8	0.7
1.2	12.64	40.4	75.1	75.7	0.6
1.3	13.26	38.2	78.4	78.9	0.5
1.4	13.89	33.6	75.5	75.9	0.4

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	10.88	54.3	68.7	75.4	6.7
0.2	11.51	49.2	70.6	76.4	5.8
0.3	12.13	45.4	73.2	78.4	5.2
0.4	12.76	41.1	74.0	78.4	4.4
0.5	13.39	36.2	72.4	76.1	3.8
0.6	14.01	33.1	73.0	76.3	3.3
0.7	14.64	32.1	77.7	80.7	3.0
0.8	15.26	28.4	75.1	77.6	2.5
0.9	15.89	26.9	77.4	79.7	2.3
1.0	16.51	25.3	78.7	80.8	2.1
1.1	17.14	23.4	78.8	80.7	1.9
1.2	17.77	21.4	77.7	79.3	1.6
1.3	18.39	19.2	74.8	76.2	1.4
1.4	19.02	19.9	82.8	84.2	1.4

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	68.7	75.7	6.9
0.2	16.64	23.2	69.1	75.5	6.3
0.3	17.26	24.1	77.8	84.1	6.3
0.4	17.89	21.9	76.7	82.1	5.4
0.5	18.51	19.5	73.7	78.4	4.7
0.6	19.14	20.1	81.8	86.6	4.7
0.7	19.77	17.5	76.5	80.2	3.8
0.8	20.39	18.1	84.3	88.1	3.8
0.9	21.02	15.2	75.4	78.6	3.2
1.0	21.64	15.6	82.7	85.9	3.2
1.1	22.27	16.1	90.5	93.6	3.2
1.2	22.89	12.8	76.7	78.9	2.2
1.3	23.52	13.2	83.6	85.8	2.2
1.4	24.15	13.6	90.8	93.0	2.2

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	71.6	79.1	7.5
0.2	21.77	15.6	79.0	86.5	7.5
0.3	22.39	16.0	86.8	94.3	7.5
0.4	23.02	12.6	73.1	78.3	5.2
0.5	23.64	13.0	79.9	85.1	5.2
0.6	24.27	13.4	87.0	92.2	5.2
0.7	24.89	13.7	94.6	99.8	5.2
0.8	25.52	9.9	71.5	75.3	3.8
0.9	26.15	10.1	77.6	81.3	3.8
1.0	26.77	10.4	83.9	87.7	3.8
1.1	27.40	10.7	90.6	94.4	3.8
1.2	28.02	11.0	97.6	101.4	3.8
1.3	28.65	11.3	105.0	108.7	3.8
1.4	29.27	11.6	112.7	116.4	3.8

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	179.6	67.8	75.3	7.5
0.2	6.38	146.0	69.7	75.3	5.6
0.3	7.01	121.4	71.2	75.5	4.3
0.4	7.63	102.3	72.1	75.4	3.4
0.5	8.26	87.1	72.5	75.2	2.7
0.6	8.88	75.9	73.7	75.9	2.2
0.7	9.51	65.7	73.4	75.2	1.8
0.8	10.13	58.4	74.5	76.0	1.5
0.9	10.76	51.6	74.5	75.7	1.2
1.0	11.39	47.3	76.6	77.7	1.1
1.1	12.01	42.3	76.3	77.2	0.9
1.2	12.64	38.5	77.1	77.8	0.8
1.3	13.26	34.2	75.5	76.1	0.7
1.4	13.89	31.4	76.2	76.8	0.6

BJOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	50.6	67.1	75.9	8.8
0.2	11.51	45.3	68.5	76.0	7.5
0.3	12.13	41.3	70.5	77.1	6.6
0.4	12.76	36.8	70.4	75.9	5.5
0.5	13.39	34.0	72.3	77.2	4.8
0.6	14.01	30.8	72.5	76.7	4.2
0.7	14.64	29.7	76.7	80.6	3.9
0.8	15.26	25.9	73.2	76.5	3.3
0.9	15.89	24.4	75.0	77.9	2.9
1.0	16.51	22.6	75.5	78.1	2.6
1.1	17.14	20.7	74.7	77.0	2.2
1.2	17.77	21.4	83.4	85.6	2.2
1.3	18.39	19.2	80.4	82.3	2.0
1.4	19.02	16.8	75.6	77.2	1.6

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	72.0	81.7	9.7
0.2	16.64	23.2	72.6	81.5	8.9
0.3	17.26	21.1	72.3	79.8	7.5
0.4	17.89	18.9	69.8	76.5	6.6
0.5	18.51	19.5	78.0	84.7	6.6
0.6	19.14	17.0	73.4	78.7	5.3
0.7	19.77	17.5	81.4	86.7	5.3
0.8	20.39	14.7	73.0	77.4	4.4
0.9	21.02	15.2	80.4	84.9	4.4
1.0	21.64	15.6	88.3	92.7	4.4
1.1	22.27	12.5	75.2	78.3	3.1
1.2	22.89	12.8	82.2	85.3	3.1
1.3	23.52	13.2	89.6	92.6	3.1
1.4	24.15	13.6	97.3	100.4	3.1

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	75.0	85.5	10.5
0.2	21.77	15.6	82.9	93.4	10.5
0.3	22.39	12.2	70.3	77.6	7.3
0.4	23.02	12.6	77.2	84.5	7.3
0.5	23.64	13.0	84.6	91.9	7.3
0.6	24.27	13.4	92.3	99.6	7.3
0.7	24.89	9.6	69.8	75.1	5.3
0.8	25.52	9.9	76.0	81.3	5.3
0.9	26.15	10.1	82.6	87.8	5.3
1.0	26.77	10.4	89.4	94.7	5.3
1.1	27.40	10.7	96.7	101.9	5.3
1.2	28.02	11.0	104.2	109.5	5.3
1.3	28.65	11.3	112.2	117.4	5.3
1.4	29.27	11.6	120.5	125.7	5.3

*****
INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	5.75	166.9	66.2	75.2	9.0
0.2	6.38	136.4	68.8	75.5	6.8
0.3	7.01	113.3	70.5	75.7	5.2
0.4	7.63	94.8	71.1	75.1	4.0
0.5	8.26	81.7	72.6	75.8	3.2
0.6	8.88	70.2	72.8	75.4	2.6
0.7	9.51	61.1	73.1	75.2	2.1
0.8	10.13	55.2	75.4	77.2	1.8
0.9	10.76	48.3	74.5	76.0	1.5
1.0	11.39	43.8	75.9	77.2	1.3
1.1	12.01	38.6	74.6	75.7	1.1
1.2	12.64	34.6	74.3	75.1	0.9
1.3	13.26	32.1	76.1	76.9	0.8
1.4	13.89	29.3	76.3	76.9	0.7

*****
INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	10.88	46.9	65.0	75.5	10.5
0.2	11.51	43.3	68.8	78.1	9.3
0.3	12.13	39.3	70.8	78.7	7.9
0.4	12.76	34.7	70.1	76.9	6.8
0.5	13.39	31.8	71.6	77.5	5.9
0.6	14.01	28.5	71.2	76.2	5.1
0.7	14.64	27.3	75.1	79.6	4.5
0.8	15.26	25.9	77.9	82.2	4.2
0.9	15.89	24.4	79.9	83.6	3.7
1.0	16.51	22.6	80.5	83.9	3.4
1.1	17.14	20.7	79.8	82.7	2.9
1.2	17.77	18.6	77.2	79.8	2.5
1.3	18.39	19.2	85.9	88.4	2.5
1.4	19.02	16.8	80.9	82.9	2.0

*****
INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	16.01	22.4	66.8	78.2	11.4
0.2	16.64	20.4	67.2	76.9	9.6
0.3	17.26	21.1	76.1	85.7	9.6
0.4	17.89	18.9	73.6	82.1	8.5
0.5	18.51	16.4	69.7	76.5	6.8
0.6	19.14	17.0	77.7	84.5	6.8
0.7	19.77	14.2	70.0	75.7	5.7
0.8	20.39	14.7	77.5	83.2	5.7
0.9	21.02	15.2	85.4	91.1	5.7
1.0	21.64	12.1	73.1	77.0	4.0
1.1	22.27	12.5	80.1	84.1	4.0
1.2	22.89	12.8	87.6	91.6	4.0
1.3	23.52	13.2	95.5	99.5	4.0
1.4	24.15	9.7	74.1	76.9	2.8

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.400 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	78.3	91.8	13.5
0.2	21.77	11.8	67.0	76.3	9.4
0.3	22.39	12.2	74.0	83.3	9.4
0.4	23.02	12.6	81.4	90.8	9.4
0.5	23.64	13.0	89.3	98.7	9.4
0.6	24.27	13.4	97.6	107.0	9.4
0.7	24.89	9.6	73.9	80.6	6.8
0.8	25.52	9.9	80.5	87.3	6.8
0.9	26.15	10.1	87.6	94.3	6.8
1.0	26.77	10.4	94.9	101.7	6.8
1.1	27.40	10.7	102.7	109.5	6.8
1.2	28.02	11.0	110.8	117.6	6.8
1.3	28.65	11.3	119.4	126.1	6.8
1.4	29.27	11.6	128.3	135.1	6.8

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	193.2	72.1	75.0	2.9
0.2	6.38	157.7	73.1	75.3	2.2
0.3	7.01	130.6	73.5	75.2	1.7
0.4	7.63	111.0	74.5	75.8	1.3
0.5	8.26	95.0	75.0	76.0	1.0
0.6	8.88	81.6	74.7	75.5	0.8
0.7	9.51	71.7	75.3	76.0	0.7
0.8	10.13	63.2	75.6	76.1	0.6
0.9	10.76	56.7	76.5	76.9	0.5
1.0	11.39	50.8	76.9	77.3	0.4
1.1	12.01	46.0	77.5	77.8	0.4
1.2	12.64	40.4	75.4	75.7	0.3
1.3	13.26	38.2	78.6	78.9	0.3
1.4	13.89	33.6	75.7	75.9	0.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	54.3	72.0	75.4	3.4
0.2	11.51	49.2	73.5	76.4	2.9
0.3	12.13	45.4	75.8	78.4	2.6
0.4	12.76	41.1	76.2	78.4	2.2
0.5	13.39	36.2	74.2	76.1	1.9
0,6	14.01	33.1	74.7	76.3	1.6
0.7	14.64	32.1	79.2	80.7	1.5
0.8	15.26	28.4	76.3	77.6	1.3
0.9	15.89	26.9	78.5	79.7	1.2
1.0	16.51	25.3	79.8	80.8	1.0
1.1	17.14	23.4	79.8	80.7	0.9
1.2	17.77	21.4	78.5	79.3	0.8
1.3	18.39	19.2	75.5	76.2	0.7
1.4	19.02	19.9	83.5	84.2	0.7

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	72.2	75.7	3.5
0.2	16.64	23.2	72.3	75.5	3.2
0.3	17.26	24.1	80.9	84.1	3.2
0.4	17.89	21.9	79.4	82.1	2.7
0.5	18.51	19.5	76.0	78.4	2.4
0.6	19.14	20.1	84.2	86.6	2.4
0.7	19.77	17.5	78.4	80.2	1.9
0.8	20.39	18.1	86.2	88.1	1.9
0.9	21.02	15.2	77.0	78.6	1.6
1.0	21.64	15.6	84.3	85.9	1.6
1.1	22.27	16.1	92.0	93.6	1.6
1.2	22.89	12.8	77.8	78.9	1.1
1.3	23.52	13.2	84.7	85.8	1.1
1.4	24.15	13.6	91.9	93.0	1.1

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	75.4	79.1	3.8
0.2	21.77	15.6	82.7	86.5	3.8
0.3	22.39	16.0	90.5	94.3	3.8
0.4	23.02	12.6	75.7	78.3	2.6
0.5	23.64	13.0	82.5	85.1	2.6
0.6	24.27	13.4	89.6	92.2	2.6
0.7	24.89	13.7	97.2	99.8	2.6
0.8	25.52	9.9	73.4	75.3	1.9
0.9	26.15	10.1	79.4	81.3	1.9
1.0	26.77	10.4	85.8	87.7	1.9
1.1	27.40	10.7	92.5	94.4	1.9
1.2	28.02	11.0	99.5	101.4	1.9
1.3	28.65	11.3	106.9	108.7	1.9
1.4	29.27	11.6	114.6	116.4	1.9

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	179.6	70.5	75.3	4.9
0.2	6.38	146.0	71.7	75.3	3.6
0.3	7.01	121.4	72.7	75.5	2.8
0.4	7.63	102.3	73.3	75.4	2.2
0.5	8.26	87.1	73.5	75.2	1.7
0.6	8.88	75.9	74.5	75.9	1.4
0.7	9.51	65.7	74.1	75.2	1.1
0.8	10.13	58.4	75.0	76.0	0.9
0.9	10.76	51.6	74.9	75.7	0.8
1.0	11.39	47.3	77.0	77.7	0.7
1.1	12.01	42.3	76.7	77.2	0.6
1.2	12.64	38.5	77.4	77.8	0.5
1.3	13.26	34.2	75.7	76.1	0.4
1.4	13.89	31.4	76.5	76.8	0.4

*****
INCLUDED SPHERE DIAMETER = 2.0J INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	50.6	70.2	75.9	5.6
0.2	11.51	45.3	71.2	76.0	4.8
J.3	12.13	41.3	72.8	77.1	4.2
0.4	12.76	36.8	72.4	75.9	3.5
0.5	13.39	34.0	74.1	77.2	3.1
0.6	14.01	30.8	74.0	76.7	2.7
0.7	14.64	29.7	78.1	80.6	2.5
0.8	15.26	25.9	74.4	76.5	2.1
0.9	15.89	24.4	76.0	77.9	1.9
1.0	16.51	22.6	76.4	78.1	1.7
1.1	17.14	20.7	75.5	77.J	1.4
1.2	17.77	21.4	84.2	85.6	1.4
1.3	18.39	19.2	81.1	82.3	1.3
1.4	19.02	16.8	76.2	77.2	1.0

*****
INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	75.5	81.7	6.2
0.2	16.64	23.2	75.8	81.5	5.7
0.3	17.26	21.1	75.0	79.8	4.8
0.4	17.89	18.9	72.2	76.5	4.3
0.5	18.51	19.5	80.4	84.7	4.3
0.6	19.14	17.J	75.3	78.7	3.4
0.7	19.77	17.5	83.3	86.7	3.4
0.8	20.39	14.7	74.6	77.4	2.8
0.9	21.J2	15.2	82.0	84.9	2.8
1.0	21.64	15.6	89.9	92.7	2.8
1.1	22.27	12.5	76.3	78.3	2.0
1.2	22.89	12.8	83.3	85.3	2.0
1.3	23.52	13.2	90.7	92.6	2.0
1.4	24.15	13.6	98.4	1JJ.4	2.J

*****
INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = J.45J SYNTACTIC FOAM S.G.= J.54J
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	78.7	85.5	6.8
0.2	21.77	15.6	86.6	93.4	6.8
0.3	22.39	12.2	72.9	77.6	4.7
0.4	23.J2	12.6	79.8	84.5	4.7
0.5	23.64	13.0	87.2	91.9	4.7
0.6	24.27	13.4	94.9	99.6	4.7
J.7	24.89	9.6	71.7	75.1	3.4
0.8	25.52	9.9	77.9	81.3	3.4
0.9	26.15	10.1	84.4	87.8	3.4
1.0	26.77	10.4	91.3	94.7	3.4
1.1	27.40	10.7	98.5	101.9	3.4
1.2	28.02	11.0	106.1	1J9.5	3.4
1.3	28.65	11.3	114.1	117.4	3.4
1.4	29.27	11.6	122.4	125.7	3.4

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	166.9	68.7	75.2	6.5
0.2	6.38	136.4	70.7	75.5	4.9
0.3	7.01	113.3	71.9	75.7	3.7
0.4	7.63	94.8	72.2	75.1	2.9
0.5	8.26	81.7	73.5	75.8	2.3
0.6	8.88	70.2	73.5	75.4	1.9
0.7	9.51	61.1	73.7	75.2	1.5
0.8	10.13	55.2	75.9	77.2	1.3
0.9	10.76	48.3	74.9	76.0	1.1
1.0	11.39	43.8	76.3	77.2	0.9
1.1	12.01	38.6	74.9	75.7	0.8
1.2	12.64	34.6	74.5	75.1	0.6
1.3	13.26	32.1	76.3	76.9	0.6
1.4	13.89	29.3	76.4	76.9	0.5

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	46.9	67.9	75.5	7.6
0.2	11.51	43.3	71.4	78.1	6.7
0.3	12.13	39.3	73.0	78.7	5.7
0.4	12.76	34.7	72.0	76.9	4.9
0.5	13.39	31.8	73.2	77.5	4.3
0.6	14.01	28.5	72.6	76.2	3.7
0.7	14.64	27.3	76.4	79.6	3.3
0.8	15.26	25.9	79.1	82.2	3.0
0.9	15.89	24.4	81.0	83.6	2.7
1.0	16.51	22.6	81.4	83.9	2.4
1.1	17.14	20.7	80.6	82.7	2.1
1.2	17.77	18.6	77.9	79.8	1.8
1.3	18.39	19.2	86.6	88.4	1.8
1.4	19.02	16.8	81.4	82.9	1.5

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	22.4	70.0	78.2	8.2
0.2	16.64	20.4	69.9	76.9	7.0
0.3	17.26	21.1	78.7	85.7	7.0
0.4	17.89	18.9	75.9	82.1	6.2
0.5	18.51	16.4	71.6	76.5	4.9
0.6	19.14	17.0	79.6	84.5	4.9
0.7	19.77	14.2	71.5	75.7	4.1
0.8	20.39	14.7	79.0	83.2	4.1
0.9	21.02	15.2	87.0	91.1	4.1
1.0	21.64	12.1	74.2	77.0	2.9
1.1	22.27	12.5	81.2	84.1	2.9
1.2	22.89	12.8	88.7	91.6	2.9
1.3	23.52	13.2	96.6	99.5	2.9
1.4	24.15	9.7	74.9	76.9	2.1

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.450 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	21.14	15.1	82.0	91.8	9.8
0.2	21.77	11.8	69.6	76.3	6.8
0.3	22.39	12.2	76.6	83.3	6.8
0.4	23.02	12.6	84.0	90.8	6.8
0.5	23.64	13.0	91.9	98.7	6.8
0.6	24.27	13.4	100.2	107.0	6.8
0.7	24.89	9.6	75.8	80.6	4.9
0.8	25.52	9.9	82.4	87.3	4.9
0.9	26.15	10.1	89.4	94.3	4.9
1.0	26.77	10.4	96.8	101.7	4.9
1.1	27.40	10.7	104.6	109.5	4.9
1.2	28.02	11.0	112.7	117.6	4.9
1.3	28.65	11.3	121.2	126.1	4.9
1.4	29.27	11.6	130.2	135.1	4.9

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	5.75	193.2	75.0	75.0	0.0
0.2	6.38	157.7	75.3	75.3	0.0
0.3	7.01	130.6	75.2	75.2	0.0
0.4	7.63	111.0	75.8	75.8	0.0
0.5	8.26	95.0	76.0	76.0	0.0
0.6	8.88	81.6	75.5	75.5	0.0
0.7	9.51	71.7	76.0	76.0	0.0
0.8	10.13	63.2	76.1	76.1	0.0
0.9	10.76	56.7	76.9	76.9	0.0
1.0	11.39	50.8	77.3	77.3	0.0
1.1	12.01	46.0	77.8	77.8	0.0
1.2	12.64	40.4	75.7	75.7	0.0
1.3	13.26	38.2	78.9	78.9	0.0
1.4	13.89	33.6	75.9	75.9	-0.0

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	10.88	54.3	75.4	75.4	0.0
0.2	11.51	49.2	76.4	76.4	0.0
0.3	12.13	45.4	78.4	78.4	0.0
0.4	12.76	41.1	78.4	78.4	0.0
0.5	13.39	36.2	76.1	76.1	0.0
0.6	14.01	33.1	76.3	76.3	0.0
0.7	14.64	32.1	80.7	80.7	0.0
0.8	15.26	28.4	77.6	77.6	0.0
0.9	15.89	26.9	79.7	79.7	0.0
1.0	16.51	25.3	80.8	80.8	0.0
1.1	17.14	23.4	80.7	80.7	0.0
1.2	17.77	21.4	79.3	79.3	0.0
1.3	18.39	19.2	76.2	76.2	0.0
1.4	19.02	19.9	84.2	84.2	0.0

BUOYANCY MODULE DATA

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INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	16.01	25.2	75.7	75.7	0.0
0.2	16.64	23.2	75.5	75.5	0.0
0.3	17.26	24.1	84.1	84.1	0.0
0.4	17.89	21.9	82.1	82.1	0.0
0.5	18.51	19.5	78.4	78.4	0.0
0.6	19.14	20.1	86.6	86.6	0.0
0.7	19.77	17.5	80.2	80.2	0.0
0.8	20.39	18.1	88.1	88.1	0.0
0.9	21.02	15.2	78.6	78.6	0.0
1.0	21.64	15.6	85.9	85.9	0.0
1.1	22.27	16.1	93.6	93.6	0.0
1.2	22.89	12.8	78.9	78.9	0.0
1.3	23.52	13.2	85.8	85.8	0.0
1.4	24.15	13.6	93.0	93.0	0.0

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.500
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	21.14	15.1	79.1	79.1	0.0
0.2	21.77	15.6	86.5	86.5	0.0
0.3	22.39	16.0	94.3	94.3	0.0
0.4	23.02	12.6	78.3	78.3	0.0
0.5	23.64	13.0	85.1	85.1	0.0
0.6	24.27	13.4	92.2	92.2	0.0
0.7	24.89	13.7	99.8	99.8	0.0
0.8	25.52	9.9	75.3	75.3	0.0
0.9	26.15	10.1	81.3	81.3	0.0
1.0	26.77	10.4	87.7	87.7	0.0
1.1	27.40	10.7	94.4	94.4	0.0
1.2	28.02	11.0	101.4	101.4	0.0
1.3	28.65	11.3	108.7	108.7	0.0
1.4	29.27	11.6	116.4	116.4	0.0

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INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	MODULE WEIGHT SOLID	NET GAIN
0.1	5.75	179.6	73.1	75.3	2.2
0.2	6.38	146.0	73.7	75.3	1.6
0.3	7.01	121.4	74.2	75.5	1.2
0.4	7.63	102.3	74.5	75.4	1.0
0.5	8.26	87.1	74.4	75.2	0.8
0.6	8.88	75.9	75.3	75.9	0.6
0.7	9.51	65.7	74.7	75.2	0.5
0.8	10.13	58.4	75.6	76.0	0.4
0.9	10.76	51.6	75.3	75.7	0.4
1.0	11.39	47.3	77.4	77.7	0.3
1.1	12.01	42.3	77.0	77.2	0.3
1.2	12.64	38.5	77.6	77.8	0.2
1.3	13.26	34.2	75.9	76.1	0.2
1.4	13.89	31.4	76.7	76.8	0.2

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	50.6	73.4	75.9	2.5
0.2	11.51	45.3	73.8	76.0	2.1
0.3	12.13	41.3	75.2	77.1	1.9
0.4	12.76	36.8	74.4	75.9	1.6
0.5	13.39	34.0	75.8	77.2	1.4
0.6	14.01	30.8	75.5	76.7	1.2
0.7	14.64	29.7	79.5	80.6	1.1
0.8	15.26	25.9	75.6	76.5	0.9
0.9	15.89	24.4	77.1	77.9	0.8
1.0	16.51	22.6	77.3	78.1	0.8
1.1	17.14	20.7	76.3	77.0	0.6
1.2	17.77	21.4	85.0	85.6	0.6
1.3	18.39	19.2	81.8	82.3	0.6
1.4	19.02	16.8	76.7	77.2	0.4

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	25.2	79.0	81.7	2.8
0.2	16.64	23.2	79.0	81.5	2.5
0.3	17.26	21.1	77.7	79.8	2.1
0.4	17.89	18.9	74.6	76.5	1.9
0.5	18.51	19.5	82.8	84.7	1.9
0.6	19.14	17.0	77.2	78.7	1.5
0.7	19.77	17.5	85.2	86.7	1.5
0.8	20.39	14.7	76.2	77.4	1.3
0.9	21.02	15.2	83.6	84.9	1.3
1.0	21.64	15.6	91.5	92.7	1.3
1.1	22.27	12.5	77.4	78.3	0.9
1.2	22.89	12.8	84.4	85.3	0.9
1.3	23.52	13.2	91.7	92.6	0.9
1.4	24.15	13.6	99.5	100.4	0.9

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INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.540
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	82.5	85.5	3.0
0.2	21.77	15.6	90.4	93.4	3.0
0.3	22.39	12.2	75.5	77.6	2.1
0.4	23.02	12.6	82.4	84.5	2.1
0.5	23.64	13.0	89.8	91.9	2.1
0.6	24.27	13.4	97.5	99.6	2.1
0.7	24.89	9.6	73.6	75.1	1.5
0.8	25.52	9.9	79.8	81.3	1.5
0.9	26.15	10.1	86.3	87.8	1.5
1.0	26.77	10.4	93.2	94.7	1.5
1.1	27.40	10.7	100.4	101.9	1.5
1.2	28.02	11.0	108.0	109.5	1.5
1.3	28.65	11.3	115.9	117.4	1.5
1.4	29.27	11.6	124.2	125.7	1.5

*****

INCLUDED SPHERE DIAMETER = 1.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	5.75	166.9	71.2	75.2	4.0
0.2	6.38	136.4	72.5	75.5	3.0
0.3	7.01	113.3	73.4	75.7	2.3
0.4	7.63	94.8	73.4	75.1	1.8
0.5	8.26	81.7	74.4	75.8	1.4
0.6	8.88	70.2	74.3	75.4	1.1
0.7	9.51	61.1	74.3	75.2	0.9
0.8	10.13	55.2	76.4	77.2	0.8
0.9	10.76	48.3	75.3	76.0	0.7
1.0	11.39	43.8	76.6	77.2	0.6
1.1	12.01	38.6	75.2	75.7	0.5
1.2	12.64	34.6	74.8	75.1	0.4
1.3	13.26	32.1	76.5	76.9	0.3
1.4	13.89	29.3	76.6	76.9	0.3

*****

INCLUDED SPHERE DIAMETER = 2.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	10.88	46.9	70.8	75.5	4.6
0.2	11.51	43.3	74.0	78.1	4.1
0.3	12.13	39.3	75.2	78.7	3.5
0.4	12.76	34.7	73.9	76.9	3.0
0.5	13.39	31.8	74.9	77.5	2.6
0.6	14.01	28.5	74.0	76.2	2.3
0.7	14.64	27.3	77.6	79.6	2.0
0.8	15.26	25.9	80.3	82.2	1.9
0.9	15.89	24.4	82.0	83.6	1.6
1.0	16.51	22.6	82.4	83.9	1.5
1.1	17.14	20.7	81.4	82.7	1.3
1.2	17.77	18.6	78.6	79.8	1.1
1.3	18.39	19.2	87.3	88.4	1.1
1.4	19.02	16.8	82.0	82.9	0.9

*****

INCLUDED SPHERE DIAMETER = 3.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	16.01	22.4	73.2	78.2	5.1
0.2	16.64	20.4	72.6	76.9	4.3
0.3	17.26	21.1	81.4	85.7	4.3
0.4	17.89	18.9	78.3	82.1	3.8
0.5	18.51	16.4	73.5	76.5	3.0
0.6	19.14	17.0	81.5	84.5	3.0
0.7	19.77	14.2	73.1	75.7	2.5
0.8	20.39	14.7	80.6	83.2	2.5
0.9	21.02	15.2	88.6	91.1	2.5
1.0	21.64	12.1	75.3	77.0	1.8
1.1	22.27	12.5	82.3	84.1	1.8
1.2	22.89	12.8	89.8	91.6	1.8
1.3	23.52	13.2	97.7	99.5	1.8
1.4	24.15	9.7	75.7	76.9	1.3

*****

INCLUDED SPHERE DIAMETER = 4.00 INCHES
SPHERE A.S.G. = 0.500 SYNTACTIC FOAM S.G.= 0.580
DIMENSIONS: LENGTH IN INCHES; WEIGHT IN POUNDS

SPHERE INTERVAL	HEXAGON DIAMETER	PRISM HEIGHT	MODULE WEIGHT IV	SOLID	NET GAIN
0.1	21.14	15.1	85.8	91.8	6.0
0.2	21.77	11.8	72.2	76.3	4.2
0.3	22.39	12.2	79.2	83.3	4.2
0.4	23.02	12.6	86.6	90.8	4.2
0.5	23.64	13.0	94.5	98.7	4.2
0.6	24.27	13.4	102.8	107.0	4.2
0.7	24.89	9.6	77.6	80.6	3.0
0.8	25.52	9.9	84.3	87.3	3.0
0.9	26.15	10.1	91.3	94.3	3.0
1.0	26.77	10.4	98.7	101.7	3.0
1.1	27.40	10.7	106.5	109.5	3.0
1.2	28.02	11.0	114.6	117.6	3.0
1.3	28.65	11.3	123.1	126.1	3.0
1.4	29.27	11.6	132.1	135.1	3.0

COMPUTER PROGRAM TO GENERATE BUOYANCY MODULE DATA

GIVEN INPUT INFORMATION ASG (APPARENT SPECIFIC GRAVITY) OF SPHERE AND DG (SPECIFIC GRAVITY) OF SYNTACTIC FOAM PROGRAM WILL GENERATE DIMENSIONS AND WEIGHT OF OPTIMUM MODEL FOR SI (SPHERE INTERVAL) FROM 0.1 INCH TO 1.4 INCH SPACING OTHER TERMS AS FOLLOWS: CPI= CONSTANT TIMES PI, WM= SPECIFIE MAXIMUM WEIGHT OF MODULE THAT CAN BE HANDLED, SR= SPHERE RADIUS, SD= SPHERE DIAMETER, DS= DENSITY OF SPHERE, DF= DENSITY OF FOAM, DHEX= DIAMETER OF HEXAGON, AHEX= AREA OF PRISM BASE, WHEX= WEIGHT OF PRISIM, NS= NUMBER OF SPHERES INCLUDED IN LAYER. NS VARYS ACCORDING TO MODEL STUDIED

```
      CPI = 4.0/3.0 * 3.141592
      WM=75.0
      KKK=-1
      DO 60 JJ=1,10
      READ, ASG, SG
      DO 50 II=1,4
      KKK=KKK+1
      IF(MOD(KKK,3).EQ.0)     WRITE(6,100)
      SD=II
      WRITE (6,300) SD, ASG, SG
      WRITE(6,400)
      SR= SD/2.0
      DS=ASG * 62.4/1728.0
      DF= SG * 62.4/1728.0
      DO 40 J=1,14
      SI = J* 0.10
      TBP = SR+SI
      TIP=(SD+SI)*0.8860
      DHEX=2.0*( 2.0*(SD+SI)+((SR+SI)/0.886))
      AHEX=2.59808 * (DHEX/2.0)**2
      HQ=(WM/DF)/AHEX
      HHEX=2.0*TBP
      NS=19
   10 HHEX=HHEX + TIP
      NS=NS+12
      IF(HHEX.GE.HQ) GO TO 20
      HHEX=HHEX + TIP
      NS=NS+19
      IF(HHEX.GE.HQ)GO TO 20
      GO TO 10
   20 CONTINUE
      VHEX=AHEX*HHEX
      VS=NS*CPI*SR**3
      VF=VHEX-VS
      WHEXS=VHEX*DF
      WHEXV=VF*DF+VS*DS
      GAIN= WHEXS - WHEXV
      WRITE(6,200) SI,DHEX,HHEX,WHEXV,WHEXS ,GAIN
   40 CONTINUE
   50 CONTINUE
   60 CONTINUE
  100 FORMAT('1',21X,'BUOYANCY MODULE DATA',//)
  200 FORMAT(F8.1,2X,F8.2,5X,F8.1,3X,3F8.1)
  300 FORMAT(     '*****',/,5X,'INCLUDED SPHERE DIAMETER ='F5
     2'  INCHES',/,
     15X,'SPHERE A.S.G. =',F8.3,'     SYNTACTIC FOAM S.G.=',F
     3/,5X,'DIMENSIONS:    LENGTH IN INCHES; WEIGHT IN POUNDS
  400 FORMAT(3X,'SPHERE', 4X,'HEXAGON' , 6X,'PRISM ',5X,
     1'MODULE WEIGHT',5X,'NET',/,2X,'INTERVAL',3X,'DIAMETER'
     35X,'HEIGHT',
     47X,'II',4X,'SOLID',5X,'GAIN',/)
      STOP
      END
```

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13. ABSTRACT

This thesis proposes a simplification of the logistic and operational problems of deep submersibles using a support craft-submersible combination. Shown is an improved vehicle launch and recovery method and a means to transfer personnel, supplies, and services during sea conditions presently detrimental to such operations. The combination is shown as capable of short range operations close to port as a complete unit, but for distant areas, the combination, which is air transportable, may require tending services of an available larger ship. A scale model of the combination was built to illustrate a method for support craft and submersible bow-to-stern mating concept. Designs for the submersible indicate how the system components can accommodate an elevator to reduce vehicle drag and to make equipment accessible for maintenance. Efficient buoyancy material is important to the idea. Small diameter porcelain spheres were made and tested to show the feasibility of sphere-syntactic foam conglomerate for buoyancy at 20,000 feet.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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Submersible						
Submersible support ship						
Submersible launch and recovery						
Sbumersible logistic support						
Submersible mating						
Submersible equipment						
Submarine support						
Submarine tankers						
Buoyancy						
Buoyancy spheres						
Syntactic foam						
Ceramic spheres						
Salvage						
Ocean Salvage						
Ocean data collection						
Lifting heavy loads						
Underwater transportation						
Deep diving system						

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